DISCOVERY

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Notes of the Month

The importance of the Sinai Bible is explained in this issue by Sir Frederic Kenyon, and in the correspondence columns we print an appeal for contributions towards its cost. The price of £100,000 may seem to be a high one, and it may be suggested that the present is not a judicious time at which to spend this sum even on so priceless a manuscript as the Codex Sinaiticus. But the cost is seen in better proportion when we recall that it is less than has been paid by the nation for a single Renaissance picture. In any case, it is more to the point at the moment to note that the whole of the purchase price is to be spent in Great Britain. There is little doubt that the appeal will have a generous response.

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The expenditure of public money unfortunately merits too often the criticism it receives. But there is at least one form of public expenditure which gives a good return: the figures quoted in the latest report of the Department of Scientific and Industrial Research should find few serious critics. During the past year the grant of one million pounds, made by the Government in 1917 for the encouragement of industrial research, became exhausted. The fund has been used by the Department for assisting the formation of co-operative research associations in various industries, maintained partly by grants from the Department and partly by subscriptions from industry. It is significant that, as a result of the expenditure of the Million Fund, industrial undertakings have thought it worth their while to contribute £1,750,000, and that, while the State is at present contributing £65,000, industry is giving £170,000 a year towards the support of a group of nineteen research associations. These have a membership of five thousand firms, covering a field of manufacturing industries which provide about fifty per cent. of the total exports of the country.

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An article on another page which describes the most modern methods used in exploring ocean beds is topical this month in view of the remarkable discovery of submarine mountain ranges in the Arabian Sea. A large area of this ocean has been surveyed by the John Murray Expedition in the fishery research ship *Mombahios*, lent by the Government of Egypt. Ten submarine mountain ranges have been found to extend in a north-east to south-west direction across the Gulf of Aden, while in the area between India and Arabia to the south of the Makran-Baluchistan coast lie two submerged mountain chains and a raised plateau, the existence of which is hardly even indicated on the present charts. The first of these ranges runs westward from the Indian coast in the vicinity of Karachi, parallel to the Baluchistan coast, while the second runs in a south-westerly direction towards Socotra; the latter range rises in places to a height of 10,000 feet above the general level of the sea-floor, and on its south-east side there is a deep valley bounded in its turn by a steep slope running up to a plateau, which slopes away in a south-eastward direction towards the swatch of the Indus River and the Kathiawar coast.

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Commenting on these discoveries, a special correspondent of the *Times* recalls the view put forward many years ago that the Baluchistan coast was a geological "fault," and the same can safely be said of the coast of Arabia. The whole general configuration of this area from the entrance of the Gulf of Aden to the Indian coast leaves little doubt that the sea floor was once a large land area, and the deep valley mentioned above was in all probability the bed of a large river and may have been the continuation,

now submerged, of the great Indo-Brahm River, which, according to Sir Edwin Pascoe and Dr. Pilgrim, formerly of the Geological Survey of India, once flowed across northern India from east to west and gave rise to the great Siwalik deposits.

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Rains of fish have periodically been reported for many years from parts of India, but this strange phenomenon has elsewhere been regarded with some scepticism. The first records of fish falling from the sky were published in 1883 in the journal of the Asiatic Society of Bengal. During the past year several occurrences of the phenomenon have been recorded in the *Statesman* of India and have attracted afresh the serious attention of meteorologists, notably Dr. S. N. Sen, of the Alipore Observatory. Dr. Sen has examined the explanations hitherto advanced, which are: that eggs may have hatched out after a heavy rainfall; that fish wrongly supposed to have fallen with rain may have been migrating over land from one stream to another; that they may have been left behind by overflows after heavy floods; or that the "rains of fish" are due to the action of heavy winds, whirlwinds and waterspouts. The last explanation seems to be the most probable. Rains of fish last occurred in the Muzaffarpore district on two days last summer. Dr. Sen has analysed the meteorological conditions for these dates and has shown that weather conditions were then favourable for the formation of waterspouts over that area.

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The value of aerial surveys in mapping large areas has been amply demonstrated in Canada. Over 500,000 aerial photographs have now been made and are filed and indexed at Ottawa ready for consultation by all who are interested in the development of the Dominion's resources. Visitors to the Air Survey Bureau include prospectors, mining and hydroelectric engineers, builders of railway and power-transmission lines, geologists and foresters. From a rapid examination of the photographs, the forester, for instance, is able to discover at a glance the types of trees that exist and the density of the forests. The mining engineer sees not only individual rocks but is able to view geological structure over a wide area, and can thus at once formulate a plan of campaign. The size of Northern Canada alone, and the shortness of the summer, render surveying on the ground an almost impossible task. To examine its whole extent even with the aid of aeroplanes will take many years. The Dominion Government is at first having aerial surveys made of areas which seem most immediately promising for development. Important prospecting work is now being carried out in the region of the Great Slave and Great Bear lakes, where major geological structures occur. Aerial surveys have lately been commenced in this vicinity, and many photographs have been taken by the Canadian Royal Air Force. A striking instance of the importance of air photographs to the mining engineer has already been provided by this survey. The photographs revealed a fault (or "dike") in this area, about two hundred miles long and almost as straight as a parallel of latitude. The knowledge that this structural feature exists, revealed at a glance in an aerial photograph, is vital to the mining engineer proposing to prospect in this area.

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A discovery of great importance for our knowledge of early man in China is announced by Professor Davidson Black in *Nature*. Dr. W. C. Pei and Mr. W. N. Pien of the Chinese Geological Survey have lately been conducting excavations at Choukoutien. In sedimentary deposits of what is known as the Upper Cave—above the strata in which the relics of Peking Man were found—these excavators have now discovered human remains together with a partially extinct fauna, stone and bone implements and traces of fire and charcoal. The human remains are said to belong to Modern Man; and the significance of the discovery is the apparent occurrence of Modern Man of late Pleistocene Age together with an industry of Upper Palæolithic type, similar to the Upper Palæolithic of Europe and Siberia. This constitutes a new record in the eastward extension to China proper of Modern Man and implements of Palæolithic Age.

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It is generally the fate of the most retiring creatures, man and beast, to receive the greatest publicity. It was therefore to be expected that the Loch Ness monster should continue to receive the attention of the Press. Unlike Sir James Barrie, however, the elusive celebrity of Loch Ness has encountered competition. Rivals had already been reported from Syracuse and Wolverhampton when a third monster took the limelight. This was a live whale weighing 55 tons which, strangely enough, eluded its owner while travelling from New York to Chicago. In view of its nationality, the announcement that the whale is thought to have been kidnapped is not entirely unexpected. It is valued at 25,000 dollars, but it is not the monetary loss which most concerns the owner. As he is reported to have said "I love that whale," we trust it has by now been restored to him, for his taste in travelling companions must surely be unique.

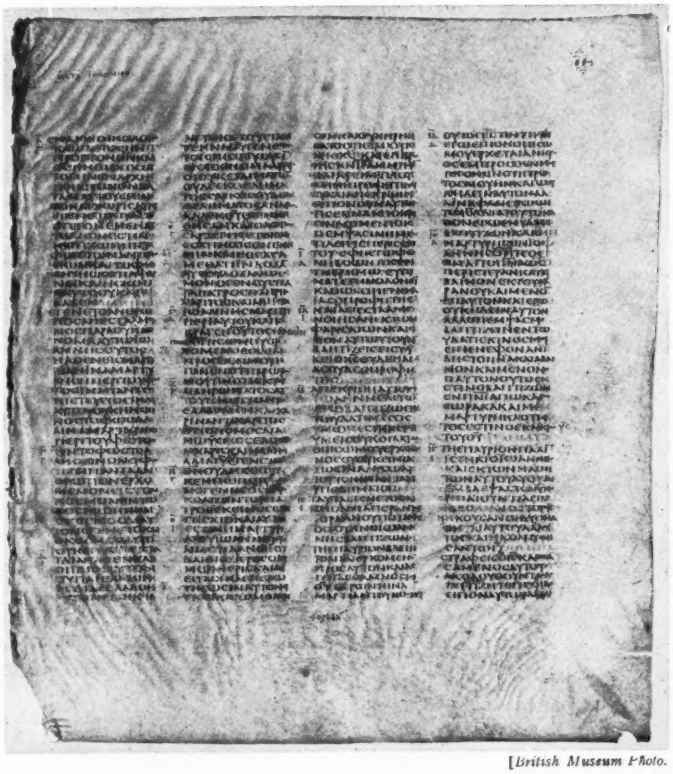
The Sinai Codex of the Bible.

By Sir Frederic Kenyon, K.C.B.

The acquisition by the British Museum of the Codex Sinaiticus, one of the oldest manuscripts of the Greek Bible, recalls the romantic story of its discovery. The importance of the acquisition is discussed by Sir Frederic Kenyon, formerly Director of the British Museum and a leading authority on the early Biblical manuscripts.

THE passing of the Codex Sinaiticus from the former Imperial Library at St. Petersburg to the British Museum recalls attention to a manuscript which seventy years ago held the centre in discussions on the textual criticism of the Bible. In 1862, when Tischendorf published his discovery in a fine edition in facsimile type (rivalling Baber's facsimile-type edition of the Alexandrinus) no manuscript of the Bible of equal age was equally well known. Seven years later the Vaticanus, which had long been unaccountably neglected, became accessible in the editions of Tischendorf and Vercellone-Cozza; and all the elements were then present for the controversy which raged over Westcott and Hort and the Revised Version.

The story of Tischendorf's discovery of forty-three leaves in a waste-paper basket at the Monastery of St. Catherine on Mt. Sinai in 1843, and of his eventual discovery of the remainder of the MS. in 1859 and its presentation to the Tsar of Russia, has often been told. It has been much in the Press lately and need not be repeated here. But the question of the intrinsic value of the MS. remains, and is revived by the consideration of the price (£100,000) which the British Museum is willing to pay for it, and for which contributions are now being asked from the public. It is the highest price hitherto paid for a single book. On this it may be said that no such book has ever been in the market before or is likely to be so unless the Vatican should begin to sell its treasures.



[*British Museum Photo.*

A page from the "Codex Sinaiticus," showing some of the corrections.

In spite of recent discoveries of fragments of earlier manuscripts on papyrus (of which an account was given in *Discovery* in November, 1933) the Vaticanus and Sinaiticus remain the two oldest copies of the Greek Bible of substantial size. The Chester Beatty papyrus consists of only thirty imperfect leaves out of a total of 110 of the Gospels and Acts. The Vaticanus contains the whole of the Old Testament except Genesis and Maccabees, and the New Testament as far as Heb. ix. 14, lacking the Pastoral Epistles and Revelation. The Sinaiticus contains rather more than two-fifths of the Old Testament and the whole of the New with the non-canonical books of Barnabas and Hermas in addition. In date, and according to most scholars, in quality, they remain the basis of our knowledge of the text of the Greek Bible.

It is also clear that a close relationship exists between them. Tischendorf indeed maintained that one of the scribes of the Sinaiticus also wrote the New Testament in the Vaticanus; but this statement (though often reported) is certainly an error and a very inexplicable one. There is, in fact, no resemblance between the hands. Lake, in his introduction to the admirable

facsimile of the Sinaiticus produced by the Oxford Press from his photographs, says that he has met no palæographer who has any hesitation in rejecting Tischendorf's claim. Nevertheless Lake himself holds that there is good reason for believing the two manuscripts to have been written in the same scriptorium. Palæographical opinion assigns both to about the middle of the fourth century. It is also now generally agreed that both were written in Egypt, though in the absence of contemporary MSS. written in other countries the proof is not conclusive; and if in Egypt, then probably in Alexandria, the only city in which volumes of such magnificence are likely to have been produced.

There are also some minor indications which point to a common origin. In any case (what is more important) there is an undeniable kinship in text. Their texts are by no means identical (Mr. Hoskier reckons that there are over three thousand differences between them in the Gospels alone); but it is clear that in the Gospels they jointly represent a recension different from that which appears in the Alexandrinus and still more from that which is found in the vast majority of MSS. and was the text of the Byzantine Church, from which our Authorized Version was translated. They must have had a common ancestor not later than the third century.

Many Similarities.

The evidence for this kinship can be briefly indicated. In Sanday's useful conspectus of important variants, 165 cases of various readings are given from the Gospels. In ten of these there is no difference among the leading uncials. In the remaining 155, ℵ.B. agree in 109 cases and differ in 46. ℵ.B. are found together in opposition to the T(extus) R(eceptus) in 99 cases and agreeing with it in 10. Taking the two manuscripts separately, the Sinaiticus (ℵ) agrees with T.R. in 31 cases and differs from it in 124; the Vaticanus (B) agrees in 27 cases and differs in 128. On the other hand the Alexandrinus (A), which is deficient in most of Matthew, agrees with T.R. in 84 cases and differs in 23. It may be of interest to add that Codex Bezae agrees with T.R. in 63 cases and differs in 70; agrees with ℵ.B. in 32, differs in 63; agrees with ℵ in 48, differs in 83; and agrees with B in 47, and differs in 86.

These figures make it quite clear that the Sinaiticus and the Vaticanus, though far from identical, are yet allies as against both the Byzantine text (T.R.) and the miscalled Western text (D), while the Alexandrinus is allied with or a representative of an early stage in the development of the Received Byzantine text. The British Museum will, therefore, henceforth possess at once the leading representative of the Byzantine text and one of the two leading representatives of the so-called Neutral text; while at Cambridge the Western text can be found in Codex Bezae.

ℵ=Codex Sinaiticus. B=Codex Vaticanus.

An Important Feature.

A special feature of the Sinaiticus consists of its corrections, which are exceptionally numerous and important. These have been carefully analysed by Tischendorf and Lake. It was somewhat considerably revised before it left the scriptorium in which it was written; but more extensive are the alterations made by a group of correctors who can be confidently associated with Caesarea and assigned to the sixth or early seventh century. One of them has added at the end of the books of Esdras and Esther notes which state that the MS. had been collated with a very ancient copy which itself, according to a note by the holy martyr Pamphilus (founder of the library at Caesarea, *d.* A.D. 309), had been corrected from a manuscript of Origen's Hexapla. These corrections, which are very plentiful, accordingly give us readings from one or more manuscripts of earlier date than the Sinaiticus itself.

It is for the study of these corrections that access to the original manuscript is especially necessary; for in the assignment of these to their several scribes the colour of the ink is of great importance, and this cannot be reproduced in a photograph. A photograph can only be relied on when (as is the case with the greater part of this MS.) the writing is clear and uncorrected; where it has been nibbed or otherwise damaged or where a corrector has been at work, no conclusion is safe unless it has been checked with the original. If anyone wishes for an example of the different ways in which photography can represent the same object he has only to compare the reproduction of the addition in Matt. xvii. 21 as it appears in Lake's facsimile in the upper margin of page 10 *verso* of the main facsimile with the same as it appears on plate 11 among a collection of specimens of the correctors' hands.

The outstanding importance of the Codex Sinaiticus will not be denied by anyone who has any acquaintance with the textual criticism of the Bible, whatever may be his views on the controversial questions connected with it. And the general public may surely feel a legitimate sense of national pride that their country has acquired one of the greatest books in the world, famous for its age and history, and important as one of the first authorities for the text of our Bible.

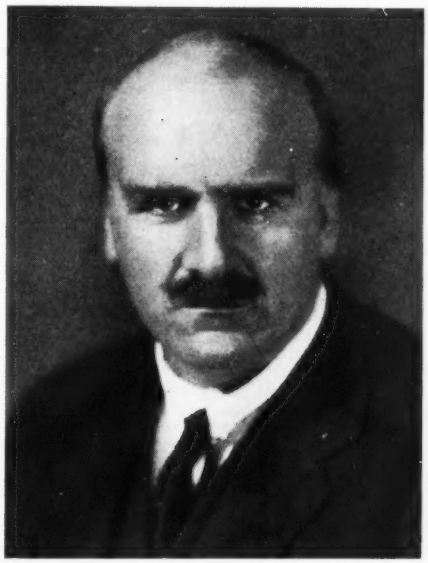
Science and Religion—IV.

A Reply to the Bishop of Durham.

By J. B. S. Haldane, F.R.S.

The Bishop of Durham opened the series of articles on Science and Religion by discussing the moral obligations of the scientist. Here is Professor Haldane's reply; he suggests that our social system is breaking down under our eyes because we have failed to adjust our ideas of right and wrong to hard economic facts.

THE Bishop of Durham dismisses the intellectual conflict between religion and science in his first section, and devotes the remainder of his article to the relationship between science and ethics, and in particular to the moral obligations of the scientist. No one will quarrel with him when he writes that "science divorced from ethics carries the potency of measureless calamity for mankind." But he does not formulate another equally important proposition: "Ethics divorced from science carries the same potency."



Professor Haldane.

The Bishop, in laying down ethical canons for science, apparently assumes that he is particularly qualified to do so. I venture to question this assumption. The voting of the majority of the bishops in the House of Lords appears to me to give evidence of an ethical standard definitely lower than that displayed by the members of the Commons. Just over a century ago the bishops helped to defeat a Bill designed to abolish the death penalty for stealing by children under sixteen. In our own time the late Archbishop of Canterbury succeeded in carrying out the Mosaic precept and visiting the sins of the fathers on the children by preventing the legitimization of a certain class of children on the marriage of their parents. Scores of other examples could be given.

The reasons for this attitude are fairly clear. Ethics, as understood by the majority of bishops and those who think like them, are not plastic and not quantitative. This is well illustrated by the Bishop of Durham's attitude to vivisection. In this case he holds that the moral issue turns on two points: "whether the reasons for which pain is inflicted—much or little makes no essential difference—are adequate, and whether such infliction does, or does not, violate the sufferer's inherent and indefeasible rights." Now science is essentially quantitative, and, as Aristotle first clearly saw, a morality informed by science must be quantitative. The amount of pain inflicted appears to me to be entirely essential. If I am riding a horse to satisfy my curiosity as to a view, it appears to me legitimate to give it an occasional flick with a switch, but no more. If I am riding to save another man's life, I believe that I am justified in whipping my horse till it is covered with blood. In so far as morality is not divorced from science, it will recognize the importance of the quantitative.

Aristotle, who was a very great biologist, saw clearly enough that right and wrong were usually quantitative. Thus, according to the amount of risk taken in a given situation, conduct is judged to be cowardly, cautious, brave, or rash. There is an optimum somewhere between two extremes, just as there is an optimum temperature for growing a plant, or an optimum hydrogen ion concentration for an enzyme. This conversion of the quantitative into the qualitative has been stressed by Hegel, and is stressed by dialectical materialists to-day. It is perfectly familiar in science, as when a substance exhibits new properties with rising temperature, or an aggregate of many similar molecules displays characters not found in a single one.

Just the same is true about "inherent" rights. I consider that it would be wrong to execute men for theft in England to-day. But it might be right in other circumstances. A man who stole half the entire ration of water in a boat in mid-ocean might,

I think, legitimately be killed by his comrades. In the same way a large section of public opinion to-day recognizes that men as such have a right to food and shelter which could not be sustained in a time of scarcity. Every scientific attempt to deal with ethics is based on the realization that ethical codes depend, among other things, on the economic structure of society.

Dangerous Ethics.

An ethic which does not realize such facts is a danger and an anachronism. One of the arguments against religion is simply that religions tend to associate themselves, not merely with a rigid theology, but with a rigid ethic. If it was right to hang men for stealing food during famines in the middle ages, it was thought by bishops to be right to hang them in the nineteenth century. If family limitation was immoral at a time when most children died before the age of twenty, it is thought to be equally wrong in an age of hygiene. If the moral code of the early Christian church was suited for the Roman Empire eighteen centuries ago, it is suited to the present age, and so on.

Although the Bishop does not condemn vivisection, he takes other opportunities to attack science. The use of poison gas, he writes, "is perhaps the most hideous and horrifying feature of modern warfare." Perhaps not. As far as can be judged from the sample of casualties officially studied, one in thirty-eight of the British casualties from "mustard gas" died, and about one in four hundred was incapacitated for six months or longer. Mustard gas is the most humane weapon ever invented. It incapacitates its victims while causing the least proportion of deaths or permanent injuries. But the bishop finds it a good argument to use against scientists. The use of poisonous gases can be condemned because it is contrary to international law, and for no other reason.

Again, referring to Huxley's "Brave New World" he says that its author has "bidden us realize what consequences would follow from the frank application of science to human life apart altogether from ethical considerations." He does not mention that in Mr. Huxley's World certain types of scientific research were suppressed as effectively as during the middle ages. Actually, this World is represented as permeated with ethics, though not by a morality which the bishop, the author, or I, find admirable. To take one example, public reference to parenthood was considered as wrong as public reference to the details of the reproductive process is considered to-day. Mr. Huxley's men and women are actually suffering from an overdose of ethics, instilled into them in their sleep. His society is filled with a passion for the standardization of men. A society in which the science of genetics was a part of the social heritage would in all probability be possessed by a passion for human diversity. To realize anything of the possibilities of diversity in an animal such as the rabbit or a plant such as maize one must visit a genetical laboratory. To realize the potentialities of human nature we shall need a society where genetics is applied to human life divorced from the ethics of Henson, Huxley, or Hitler, but based on an admiration of the variability of man.

Such mistakes as these do not occur by chance. They indicate a deep-rooted antagonism to science which is entirely understandable in a representative of official religion. On reading the Bishop's second paragraph, one would suppose that the conflict between science and religion was over; at least in the intellectual sphere. As long as religions continue to teach doctrines which, if they are true, can be verified, such as the intervention of God in the affairs of the world, and the survival of death by individual men, science will demand that the evidence should be examined by scientific criteria; and it is for the Bishop to show reasons why the evidence for such beliefs is likely to prove more cogent in the future than it has in the past. He has carefully avoided any serious consideration of the intellectual conflict between science and religion. And no wonder. It is an unequal conflict. I must, however, thank him for not repeating the statements, so often heard on the lips of defenders of religion, that science has hopelessly discredited materialism, and that the creation of the world or of life is implied by the data of astronomy or biology. It would be truer to state that recent work, by emphasizing the complex properties of the simplest units of matter, has made materialism far more plausible than was the case ten years ago, and that about two thousand million years ago the structure of the universe was probably so unlike its present structure that arguments about it are likely to be fallacious.

Discrediting Science.

Meanwhile a simple technique is being developed for the discrediting of science in the ethical sphere. Its applications may be misrepresented, as in the case of war gases. Or science may be attacked because its products are misapplied. Boots are just as essential for war as bullets. But no one attacks the devilish craft of the bootmaker. Enemies of science find it comforting to their consciences to condemn the scientist who invents a propellant explosive, rather than the ethic which determines that this explosive should be used for killing men rather than, say, transporting

them through space. The human effort expended on the great war would almost certainly have sufficed to abolish several of the major diseases, or to establish a human colony on the moon. Now ethics is a system of the ends which men think worth while. Neither of the ends which I have suggested are thought worth while because ethics are divorced from science.

Science has had a huge influence on our technique, but very little on the ends to which it is applied. The Bishop of Durham is doing his best to put off the latter change by the suggestion that moral obligations are not themselves functions of existing knowledge and technique.

Social Breakdown.

There are three possible relations between science and ethics. Science may have a negligible influence either on practice of theory, as during most of human history. It may influence the practice and the theory, a condition for which we may hope in the future, and which has been realized in this country to some very slight extent as the result of the efforts, in the teeth of clerical opposition, of such men as Bentham. Or we may have the present situation, where our practice is everywhere permeated by science, but our ideas of right and wrong are largely mediaeval ideas which worked at least passably well in a very different type of society. Our social system is breaking down before our eyes owing to our failure to adjust these ideas to hard economic facts. The Bishop of Durham, unwittingly no doubt, but effectively, is doing his best to encourage that breakdown.

Mr. Belloc's article is another story. He admits the reality of the conflict between science and religion, and states its grounds with his customary clearness, and with conspicuous moderation. Nevertheless, the case for science is somewhat stronger than he would have us believe. He tells us that the scientific spirit relies on the authority of two dogmas. One is "the unity and self-sufficiency of the material universe, and therefore the immutability of sequence in cause and effect." The other is that the only valid proof "is proof through things measurable." It is true that certain scientific men have held each of these beliefs. Others, just as antagonistic to the claims of theology, hold neither. I belong to this latter group.

The self-sufficiency of the material universe is a useful working hypothesis, useful above all because it can be tested. At the present moment many of my colleagues, in a thoroughly scientific spirit, are testing the claims of spiritualism to prove that the material universe is subject to interference from immaterial beings. Only a minority hold that such interference is proved. But the others are so far from taking the dogma for granted that they have spent considerable time in investigating its alleged violations. Nor do all scientists believe in the immutable sequence of cause and effect. The uncertainty principle, which is widely held by physicists, allows a considerable latitude in this sequence, and yet appears to offer a satisfactory basis for science.

Nor does all scientific proof rest on measurement. Scientists regard certain theorems of mathematics, for example $a^2-b^2=(a+b)(a-b)$ as a great deal more certain than any law based on measurements, for example, the law of the conservation of energy. Laws of the latter type are not regarded as certain, but only as more likely to be true than statements based on intuition, or the authority of an institution or book, to which Mr. Belloc contrasts them. Unfortunately a satisfactory account of the logic of science does not exist, for the simple reason that science is growing. But Mr. Belloc would find a summary which many scientists are willing to accept in Jeffreys' *Principles of Scientific Inference*. I do not think that its author subscribes to either of the dogmas which Mr. Belloc regards as authoritative for the scientific spirit.

Mr. Belloc's example of a scientific error is not happily chosen. He says that Natural Selection is regarded as the agent of growth, and retorts that an acorn does not become an oak by natural selection. This is obvious enough, but does not disprove the Darwinian view that natural selection picked out the particular type of growth leading to an oak tree from a large number of types which were competing for perpetuation. His statement that in every generation "selective advantage diminishes in geometrical proportion," is unintelligible to me at any rate. As the author of ten papers on the mathematical theory of natural selection, I wish he would expand it, for I at least cannot see why, if a grey mouse is two per cent. fitter than a black in 1933, this advantage should be lessened in 1934.

A Criticism of Mr. Belloc.

Finally Mr. Belloc lays the blame of various modern tendencies of which he disapproves to the scientific spirit. For example, the scientific spirit, so he tells us, tends to make marriage a contract determinable at will, the religious spirit, to make it an indissoluble union. On this view the prophet Muhammad, who made divorce extremely easy for husbands, must have had an overdose of the scientific spirit. In the same way the scientific spirit is said to tend towards the limitation of child-bearing. I had always thought

that this practice was strictly limited in religious orders. The scientific spirit which, in Mr. Belloc's view, bases itself on measurement leads to the conclusion that the birth-rate in England is so low that the population is likely to decline catastrophically, no matter what hygienic measures are taken. It therefore follows that unless this is considered desirable, steps should be taken to increase the birth-rate.

The truth is that in an age where science is valued, any movement can gain adherents by describing itself as scientific. Among such movements are those for birth control and sterilization of the feeble-minded. Thousands of people swallow this bait whole. I am a little surprised to find Mr. Belloc among their number.

I entirely agree with him that the conflict between science and religion is a reality. But it will be fought with the least possible damage to humanity if it is restricted to essentials. The persecution of unorthodox opinions is carried out to-day by States as it was in the past by Churches. It is therefore not peculiar to the religious spirit. The limitation of population is found in many quite unscientific communities, for example, the Polynesians. It is therefore not specifically scientific. Science and religion have sufficient grounds for disagreement to obviate the need of so confusing the issue between them.

Experiments in the Stratosphere.

It has recently been reported in the daily Press that an attempt is shortly to be made by balloon ascent to reach higher altitudes than 61,000 feet (pressure 50 mm.) claimed to have been reached by Prokofiev and his companions in the U.S.S.R. balloon. It will be recalled that observations were made by Regener in 1932 using self-registering apparatus attached to rubber balloons up to a pressure of 22 mm. It was reported that two American balloonists reached a pressure last autumn of about 64 mm., while the minimum pressure from the records of the Belgian flights of Cosyns, Kipfer and Piccard was 73 mm.

A contributor to *Nature* explains that the new attempt represents a departure from the previous methods in that the observers are to travel in an open basket, but will themselves be completely sealed in flexible rubber suits. To prevent these from ballooning at low external pressure the suits, adequately supported, will be exhausted down to the minimum that a man can withstand with comfort if he be supplied with sufficient oxygen. The advantages claimed are that the great saving in weight by the absence of the heavy gondola of the previous flights will enable the observers to reach greater heights. The apparatus has already been tested with safety up to an external pressure supposed to correspond to a height of 90,000 feet—roughly that attained by Regener's balloons. It is assumed that the ballooning of the suit at the greatest height attainable will not incommode the occupant even though he himself is under a very much reduced pressure. The observer will be enabled to move about freely and make meteorological and other observations with instruments in contact with the atmosphere.

It is true that from the point of view of record breaking this saving in weight is an important feature, for it was made clear by Dr. M. Cosyns, when lecturing in England a short time ago, that the only practical limits imposed turned on the very awkward elongated cigar shape of an extremely large envelope when filled with hydrogen only to a small fraction—one-fifth or one-tenth—of its capacity on the ground. The whole risk lies with the possible entangling of the practically parallel ropes supporting the gondola. When once off the ground the mishap cannot be rectified. So great was the risk that, in the last Belgian ascent, the balloon was purposely filled with twice as much hydrogen as was required in order to keep the ropes apart, the surplus being discharged en route.

An interesting result of the Russian ascent was the discovery that the composition of the air is the same at the lowest pressure reached as on the ground, and that the relative humidity fell from 92 per cent. on the ground to 42 per cent. on the borders of the stratosphere. On the new ascent spectrometers for recording the sun and sky light, pyrheliometer for determining the solar constant, air samplers and camera can all be worked in the open instead of in a sealed chamber. Eyes and ears must unfortunately always be enclosed. The deep purple of the sky noticed by both the Belgian and the Russian observers must always be seen through glass. Of all the observations likely to be made, the greatest promise comes from the projected Wilson chamber experiments by Dr. Cosyns; the need for a further examination of cosmic rays is urgent, for their origin remains unknown. The Wilson chamber set will be used for photographing "beta"-rays and cosmic rays.

Apart from the investigations in pure science for which such heroic efforts have recently been made and are likely to be made in the future, the new methods to be adopted on the latest ascent have reopened the question of the feasibility of employing such equipment in an open aeroplane flying the stratosphere. It is claimed that the control will be easier than from a completely sealed cockpit.

New Discoveries in the Agora of Athens.

By T. Leslie Shear, Ph.D.
Director of Excavations.

The first season's work in the Agora of Athens was described in DISCOVERY *by Professor Shear a year ago. Further discoveries of great interest have since been made. Apart from statues and other works of art, the number of inscriptions uncovered now exceed one thousand and are of considerable historical importance.*

EXCAVATIONS in the Athenian Agora during the past season were conducted in four city blocks after the modern houses there located had been demolished and removed. The most northern area lies between Poseidon and Eponymon Streets, just east of the Kolonos Agoraios on which stands the Theseum. One of the gratifying incidental results of the clearance of this terrain to the Greek and Roman level is the present pleasing appearance of this temple, which now gracefully and beautifully stands against the background of the blue sky, as it was seen by the ancient Athenians strolling along the streets of the Agora. The clearance of this sector, lying east of the Royal Stoa which had been partially excavated in previous campaigns, led to the uncovering of the foundations of the east front of the stoa and to the discovery of pieces of architecture and of sculpture which evidently belong to that building.

The earth in front of the stoa was filled with broken pieces of marble, among which were lying shattered fragments of two marble statues of a winged Niké. One of the statues is fairly well preserved. The Niké, which is standing on its original base, has the appearance of flying to the left with the right arm raised aloft, while the left hand, clasping the drapery, hung down by the side. The figure itself is full of life, grace and action. The type of the figure and the weathering of the marble suggest that the statue may have served as an akroterion, and as it was lying in front of the south end of the stoa it is probable that it originally stood on the south wing of that building. Its style points to a date at the end of the fifth century B.C., the period to which the stoa had already been assigned on the basis of architectural and archæological evidence.

A most unexpected discovery in this sector was that of a Mycenæan burial. In a small area surrounded by the walls of Byzantine houses the remains of three skeletons were lying close together just beneath the floor level of the classical period. With them were fragmentary vases of the late Mycenæan period, one blue glass bead, and a gold signet-ring. The scene represented on the ring evidently has some religious or sacrificial significance. The group consists of three figures, two women and a man. On the right the man, who has the head of an animal resembling a bull, is striding to the right holding a long spear or branch in one hand and in the other a double cord or ribbon, which is fastened to the waist of the foremost of the two women. The women are dressed in characteristic Creto-Mycenæan costume, with ruffs about the neck, and with skirts which have a thick roll about the waist and four flounces on the lower part. Behind the women, on the extreme left, is a small column, and in the field at the top is an object which resembles a tiny bird. The association of the bull-headed man and the captive women recalls the story of the Minotaur and the sacrifice of the Athenian maidens, but it would be surprising to find a mythological representation at such an early period. Whatever

[*Photo: H. Wagner.*

A new view of the Theseum as it appears from the excavated area of the Agora at Athens.

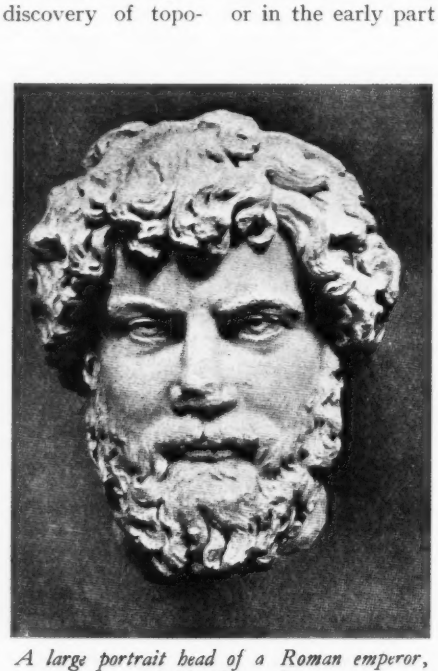
the interpretation of the scene may be this is an extraordinary object to be found in the Athenian Agora.

The second area of the excavations lies farther south between the same modern streets. Here the extension of the great drain, which passes through the northern sectors, has been uncovered. It makes a bend to the east and at the edge of the area branches into two forks, of which one leads to the east and the other to the south-west. Since the drain probably followed the course of the ancient road it is clear that two routes led out of this part of the Agora, one passing between the Acropolis and the Areopagus, and the other between the Areopagus and the Pnyx. According to the description of Pausanias the sanctuary of the Mother of the Gods should be located in this vicinity, and topographical significance is therefore attached to the discovery here of several roof-tiles with dedications to that goddess. Some marble statuettes of the Mother were also found in the same general neighbourhood.

The drain passes through the third sector of the work, which lies just east of the second, leaving it on the south side. The main discovery of topographical interest in this area is the foundation of a large rectangular building which extends east and west through the entire sector for a distance of nearly sixty metres. The archæological evidence shows that the foundation dates from the Hellenistic period. The only large building which should be located here according to the usual interpretation of the route followed by Pausanias is the Bouleuterion, the meeting place of the Boule (Council), which was composed of 650 members in the latter part of the third century B.C.

The fourth block of the excavations lies south of the Stoa of Attalos. A great wall has been uncovered here which extends north and south throughout the area. The wall is constructed of two faces made of heavy re-used blocks with a space between them of 2.25 m. This space is jammed with heavy architectural members, including architrave and cornice blocks, drums of columns and a perfectly preserved Doric capital. Many of the marbles are excellently wrought in a good technique, and may belong to the building of which our first record is now derived from an inscription which is embedded in the eastern face of the wall. This inscription, written on the lintel of a large portal, states that the priest of the Muses, T. Flavius Pantainos with his children, Flavius Menandros and Flavia Secondilla, from their private means dedicated the library, with its books, the outer stoas, the peristyle and all the decorations in the building to Athena Polias, to the Emperor Cæsar Augustus Nerva Trajan Germanicus and to the city of the Athenians. The date of the inscription is close to A.D. 100. Nothing is otherwise known about the library or about the man who presented it to the Athenians. It is surprising that a library of the size indicated by the architectural members should have existed in such comparative proximity to the library of Hadrian. The discovery is of great importance both from the historical and from the topographical points of view.

Evidence provided by coins and pottery proves that the wall was built in the latter part of the third or in the early part of the fourth century A.D. Two towers have been uncovered in the stretch which has so far been investigated. Not only were architectural blocks used in the construction but pieces of sculpture were also employed for the same purpose. A marble base with relief decoration was taken from a wall of the north tower. The scene on its face represents a quadriga with the four prancing horses being reined in by the driver while an armed warrior mounts the chariot. Its style places it in the fourth century B.C.



A large portrait head of a Roman emperor, probably Commodus.

A colossal statue of a woman had been carefully placed in the wall of the south tower into which it had been thoroughly cemented. The cement is not hard and can be entirely removed by soaking with water. After it had been taken from the wall the statue proved to be an imposing figure in spite of the lack of head and the right arm.

A modern chapel in this block, dedicated to St. Spyridion, has walls decorated with late Byzantine

frescoes, perhaps dating from the seventeenth century. The Annunciation is represented on the east wall, while on the south a series of panels exhibits numerous saints, both men and women. The dashing soldier Saint Demetrius occupies a conspicuous panel. Clad in the panoply of war, with elaborately ornate armour, he rides a spirited steed over the prostrate body of the giant Lyæus, while he holds by the hand the little Nestor on the horse behind him. The reference is to the scene at Thessalonica when the pious Nestor with the help of the saint slew in combat the wicked Lyæus favourite of the Emperor Maximianus. When arrested and executed by order of the Emperor he was borne by Demetrius to a brighter and a better world.

An Attic black-fiugred skyphos, of the sixth century B.C., among the many beautiful examples of pottery discovered during the past season.

The area of the Agora is honeycombed with well-shafts which vary in type of construction and which date from widely different periods. Some of the wells are quite modern, while others were built in antiquity and were abandoned after a short period of use. It is obvious that the homogeneous nature of such closed deposits is of great value for chronological data. One of the most productive of the shafts was a rectangular cutting in the rock of the Theseum Hill. With a few earlier exceptions all the 217 objects from this deposit date from about the middle of the sixth century to 480 B.C., when the top of the shaft was filled in.

The earliest object from the shaft is a magnificent amphora decorated by a sphinx on either side, which almost completely fills the available space. The sphinx is of archaic type with the head in profile but with the eye represented as if seen in front view. The leonine forelegs and paws are stretched far out in front of the body and the tail is curled between the hind legs. Varying soft tones of purple are interspersed with black and red to produce a most pleasing decorative effect. Rosettes are scattered in the few spaces not occupied by the sphinx, and are closely placed round the edge of the rim, while palmettes and lotus buds are grouped about the base of the handles. This fine specimen of early Attic ware must be dated close to the end of the seventh century B.C.

Another interesting example of early black-figured pottery is a two-handled bowl which is decorated with groups of figures arranged in panels on either side. In the main panel on one side Herakles is seen in a chariot, driving a pair of centaurs. He wears the lion's skin belted round his waist and brandishes the club with his right hand while holding the reins in the left. The bearded centaurs have human upper bodies and equine forelegs.

Among the many early red-figured vases from the shaft one cylix is conspicuously beautiful because of its contrasting colours. The rim of the vase and the background of the medallion are painted a rich, glossy black, while the body of the bowl is an equally well-polished red. The effect of this colour combination is most striking, but in spite of its beauty the device seems not to have been popular, since comparatively few vases painted in this technique have been found.

A group of six *ostraka* with the names of Hipparchos, Megakles and Hippokrates was found in the same stratum with the cylix which has just been described. Higher up, by two to three metres, there were other *ostraka* with the names of Aristeides and Themistokles which were voted in 483 B.C. These are among the latest objects in the deposit and indicate that the shaft was finally closed with a top-filling of débris from the clearing up of the city after its destruction by the Persians. The fixed dates provided by these documents are of great value in determining the chronology of the pottery and other objects found in association with them.

The loveliest object from the shaft is a plastic vase in the shape of a kneeling boy. Above the head are the neck and lip of the vase. The hair is arranged in conventionalized strands which hang low on the back, and the eyes slant upwards in characteristic archaic

style. The arms are upraised and the hands are loosely clasped as if they may have held the ends of a ribbon which passed around the neck of the vase. The details of the figure, such as the fingers and toes, are rendered with the utmost care. The exquisite modelling of the body, the subtle interpretation of accurate details of muscular reaction due to the kneeling position, the superb finish of the surface, mark this as a masterpiece of archaic art, dating, perhaps, from the third quarter of the sixth century B.C.

A Wealth of Vases.

Among the great quantity of vases of all periods which have come from the other wells scattered through the Agora, one example only is selected because of the interest of its decorative group. This is an Attic black-figured *skyphos* which has, on each side, the representation of a youth who is riding an *hippalektryon* between two standing women who are gazing at the strange spectacle. The mythical cock-horse is rearing with his equine forelegs, and it is not difficult to appreciate the look of astonishment on the faces of the women at the sight of the monster.

The year's work has been particularly productive in the field of sculpture. Besides the statues already mentioned there are other monuments of both Greek and Roman periods.

The finest portrait is one of the young Augustus, a masterpiece of Roman art. It has the protruding ears characteristic of Augustan portraits, and the hair is combed in the usual manner. The typical treatment of the lips and the chin also confirms the identification. The delicate carving of the eyelids, the modelling of the cheeks, the delineation of the muscles are admirably wrought, and the surface of the marble is beautifully finished. Power and determination are successfully suggested in every line of the features. A work of this excellence gives a true appreciation of the ability of the artist of this period to comprehend his subject, and of his technical skill to execute it in marble.

Another Roman head, though of different type and of later date, is equally characterized by its virility and its originality. This is a colossal head which is perfectly preserved except for a chip at the end of the nose. The hair of the head is abundant and is carelessly arranged. The eyebrows are characteristically indicated and the pupils of the eyes have been bored with a drill. The expression of the features is dignified and benign, and they somewhat resemble the portraits of the Emperor Commodus. The head is excellent in workmanship and in appearance.

The marble perfectly preserved bust of a woman also obviously represents the portrait of some individual, and indeed an individual of firm character and of strong will. The expression of the features, achieved by the modelling of the cheeks and by the tight compression of the lips, characterizes a woman who is accustomed to rule. The hair is parted in the middle, arranged in undulating waves on each side, and terminated in a braided knot at the back. The head resembles portraits of the younger Faustina which appear on some Imperial coins.

The last of this remarkable series of Roman portraits is a head which is astonishingly life-like in appearance. The rumpled hair, the wrinkled forehead, the heavy eyebrows, the expression of the eyes, the lines on either side of the nostrils, the shape of the mouth and the closely-cropped beard all denote salient characteristics of an individual of pronounced personality. The style of the work and technique of its craftsmanship point to a date at the end of the second century A.D., but it has not been possible to identify the man with any known person.

Apart from the works of art produced by the excavations, some of which have been described, there is an immense amount of other important material. The number of inscriptions now exceeds one thousand, and many of them are of considerable historical importance. Two inscribed marbles have particular interest. One contains part of the epigrams written in elegiac distichs by Simonides and Aeschylus in honour of the Athenians who fell in the battle of Marathon. The other is part of the auction list of the effects of Alcibiades which were seized and sold after his conviction on the charge of mutilating the herms in the Agora in 415 B.C. In addition to much other historical information, the new discoveries have necessitated some thirty additions and corrections to the previously known calendar of the Athenian archons.

Foreign Relations.

There are now in the Agora collection twenty-four thousand coins which not only illustrate the coinage history of Athens but throw light on the foreign relations of the city in their many ramifications. The series of lamps, which number nearly 1,200, is a very representative one, and the many terra-cotta figurines illustrate the products of this minor art over a period of 1,200 years. All the objects are preserved in a temporary museum in the Agora. The modern houses in other city blocks are now being expropriated and excavations were resumed in January.

Exploring the Bed of the North Atlantic.

*The study of oceanography has made great progress in recent years. The recovery of deposits from the bed of the Atlantic is likely to solve the problem of whether the bottom of the ocean was ever above sea-level. And there is reason to expect that deep-sea animals may be brought to the surface alive when apparatus is perfected.**

UNTIL recent years physical oceanography was too frequently considered a branch of science having little importance except to those interested in the ocean itself. This feeling perhaps resulted from the fact that in the early days the main emphasis was placed on marine biology, and physical observations were first made mainly with the purpose of exploring the environment of marine plants and animals. Later there developed the necessity of studying the ocean currents and their influence in the transportation of sea life. As a result the physical oceanographer came to be thought of as one who charted the various physical characteristics of the ocean and who had as his ultimate goal the understanding of oceanic circulation.

But it is now becoming increasingly evident that several other branches of science must turn to the sea (and therefore to the oceanographers) for help, for only in oceanography can be found the men and equipment for the investigation of the ocean and the problems related to it. Let us briefly consider some examples in which the oceanographer can do important work outside the original conception of his field.

In the first place, geology is naturally much concerned with the ocean basins. Have they been permanent features on the earth's surface, or in the past has there been dry land where now the chart shows one or more thousand fathoms of water? Convincing proof that will settle this problem one way or another can perhaps be brought to light by the oceanographer. A careful study of marine deposits might point to former land bridges between the continents in such a way that they could be accurately located and even dated, much to the satisfaction of all students of the geographic distribution of modern plants and animals, as well as to geologists. Perhaps a less spectacular problem is that of the formation of continental "shelves." Again there is reason to believe that the question can best be settled by a careful study of bottom deposits. Thus oceanographic institutions, having developed a technique for bringing up deep-sea mud in the course of exploring the oceans, are now realizing more fully the importance to geology of this type of work. With proper equipment much can be learned from the ocean bed which will extend geological knowledge beyond the beach line and perhaps open up a sounder theory for the formation of the earth's surface.

In the same way, but perhaps not to the same extent, meteorological investigations have been largely confined to the air. Not only is there much meteorological research work to be done at sea but this science is closely bound up with oceanography. For example, how much influence have fluctuations in the ocean currents on variations in climate and vice versa? From a more technical standpoint, students in dynamic meteorology and dynamic oceanography now see more clearly how similar is the principle of the circulation of the atmosphere to that of the ocean. Thus we can expect in the future a closer relationship between the physical oceanographer and other geophysical students, for many of their problems are related.

On the other hand, the scope and importance of marine biological work has been more generally

The research ship "Atlantis" which has been engaged in the work described in this article.

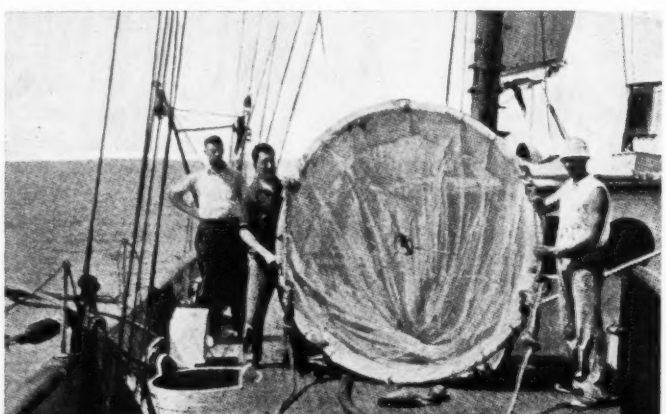
* Annual Report of the Smithsonian Institution.

recognized and in certain lines (for example, fisheries investigations) has developed relatively fast. The many marine laboratories of the world are good evidence that physiologists have realized the importance of studying life in its most natural environment. Hand in hand with the development of marine biology has gone the study of the chemistry of sea water and such questions as the penetration of light below the sea surface and its influence on the life in the upper water layers. Thus at the present time oceanography has passed the stage of a science in which the collection and tabulation of facts is considered the main aim, and it is now evident that much productive research of wide interest can be carried out at sea.

The investigation of the ocean naturally divides itself into deep-water problems and shallow-water problems. The well-known fact that most continental land masses are surrounded by a broad, relatively shallow shelf of water less than 100 fathoms deep and that the ocean basins are uniformly twenty or thirty times as deep, serves to emphasize this distinction. Investigations along the coast and even out as far as the edge of the continental shelf can be carried out from almost any boat and with quite inexpensive equipment. Deep-sea oceanography, on the other hand, is an expensive undertaking requiring a strong, able vessel and elaborate winches and instruments. For these reasons there are a number of scientific institutions actively engaged in studies of the shallow-water areas of the ocean but relatively few can conduct researches outside the hundred-fathom curve. In several ways this has been unfortunate in the development of some phases of oceanography, because the shallow waters over the continental shelves are usually much affected by the circulation of the waters of the ocean basins, while tidal and other influences often obscure the the picture to such an extent that isolated problems cannot easily be settled.

On the other hand, the shallow water areas are, of course, the seat of the world's fisheries and for that reason merit governmental study. But even in the case of fisheries investigations the oceanic waters cannot be ignored, because it has been shown that the sudden failures of a fishing ground are sometimes caused by movements of the oceanic waters which periodically flood in over the banks, changing the temperature of the bottom water and driving off the fish. In other words the investigation of the sea has progressed largely from the shore outward, while it is now evident that there would have been some advantage to oceanography as a whole if it had been possible to put more effort into deep-sea investigations during the early stages of the science. It is perhaps not an exaggeration to say that the heart of most oceanographic problems is to be found in the deep ocean beyond the limits of the continental shelves.

The fact that there has recently been established in the United States an institution largely devoted to deep-sea oceanography is therefore of considerable interest. The Woods Hole Oceanographic Institution, with its headquarters on Cape Cod, is ideally situated for the investigation of the North Atlantic. The main distinction between an oceanographer and other men of science is that the oceanographer goes to sea. His ship is the all-important part of his scientific equipment, for he must be able to make observations in all kinds of weather and at great depths. Not only must he often remain far out at sea for months at a time, but also he must be ready to take an active part in securing his observations.



This photograph shows the "current meter" fastened in the mouth of a net to measure the volume of water passing through.

Many kinds of vessels can be used for oceanography with good results. Fishing craft of various types have proved very satisfactory. The main points are that the vessel should be entirely seaworthy and able to remain at sea longer than ordinary commercial usage requires. For the investigator of the chemistry of sea water especially, the steadier the

ship, the more accurate will be his work. But to gain steadiness by using a large ship is often a disadvantage. If the boat is too large, besides being expensive to operate, the scientists are not close enough to the water to handle easily much of their equipment. One solution is to use a sailing vessel, because the sails tend to prevent the boat from rolling excessively in a rough sea. In oceanography, then, we find one instance at least where the sailing ship can hold out successfully against the inroads of steam.

One of the most modern examples of a scientific research ship is the *Atlantis* operated by the Woods Hole Oceanographic Institution. She was built especially for the work after considerable thought and embodies the experience of many men familiar with carrying out scientific work at sea. She is powered with a 280 horse-power Diesel engine, which besides propelling the ship at a speed of 9 knots in calm weather, supplies through a dynamo the power for the heavy trawl winch. A much smaller Diesel engine generates the power for light, ventilation, and refrigeration, as well as for the hydrographic winch. Perhaps the most specialized piece of equipment is the trawl winch, located, because of its great weight, in the lower hold. It carries 5,000 fathoms of special steel cable of ½-inch diameter, with a breaking strain of about 12 tons. The hydrographic winch, used mainly for lighter work such as securing deep-sea temperatures and water samples, carries a similar length of much lighter wire and is located on deck. Both winches are electrically driven and fitted with automatic devices for guiding the wire smoothly on the drums.

The *Atlantis* accommodations include cabins aft for a scientific staff of five, and amidships two laboratories, one opening out to the deck where the rough work is done, and another directly below it where the chemical analyses are carried out and where the micro-biologist can examine the catch of his silk net without being disturbed. The permanent crew, exclusive of the scientific staff, numbers seventeen men.

The plankton net being hoisted aboard and washed down by a hose.

The primary instrument of the physical oceanographer is the deep-sea reversing thermometer. These are now sent down in pairs, one open to the pressure of the water and the other enclosed in a heavy glass case. The significance of this we will see presently. Both the protected and the unprotected thermometers are of the same construction. On being turned over, the column of mercury breaks off at a constriction in the capillary and the temperature is read as the length of this detached thread of mercury. Thus the reading cannot be changed on the long haul to the surface by passing through the much warmer surface layers. The deep-sea thermometers are now very accurate and can record the temperature to a hundredth part of a degree centigrade. The pairs of thermometers are sent down in frames which are mounted on the side of instruments known as water bottles. These are fastened to the wire cable at suitable intervals and lowered over the ship's side. A small weight, or messenger, is then slid down the wire, which, on striking the uppermost instrument, closes the openings of the water bottle, reverses the thermometers, and releases another messenger which slides on down the wire and repeats the operation with the next instrument. Thus a series of ten or more water samples and pairs of thermometer readings can be secured at one lowering. In deep water it may take several such lowerings, each successively deeper, to constitute a "station."

The primary collecting instrument of the marine biologist is, of course, a net of one sort or another. Many different types are employed, depending on what type of animals or plants are sought and on whether the collections are to be obtained from the bottom, the surface, or intermediate depths. Of late years attention (formerly directed chiefly to the bottom fauna) has been largely centered on the drifting community of animals and plants—the "plankton"—which are captured as a rule with some form of tow net. Tows made deep down in the water have until recently been confused by the same inaccuracy as have the

routine physical observations, namely, the uncertainty as to the precise depths from which the captured specimens came. Not only was the maximum depth reached by the net uncertain but also the animals might have entered it on the way down or on the way up.

This last source of error is especially serious in the case of deep-sea tows, for with these the time involved in lowering and raising the net may be several times as long as the horizontal tow itself. Even for plankton work near the surface it has been difficult to know at just what depth the net had been fishing or to do accurate quantitative work with more than one net at a time. Improvement in the technique of tow-net work has come gradually and is perhaps not yet at a satisfactory stage of development.

One of the first steps was the perfecting of nets which can be sent down closed, opened during the tow, and closed again before being hauled to the surface. Another improvement has been the use of a kind of bucket at the back of the net which protects the catch from being rubbed too much against the netting during the long haul to the surface. As many deep-sea animals are ruined as specimens through this cause as through the release in pressure on nearing the surface. This destructive release in pressure, which at first destroyed nearly all specimens of deep-sea fish by causing gas bubbles to form in the tissue, can now be fairly well prevented by using much the same methods as employed in raising a diver.

Recently on the *Atlantis* it has been found possible to make as many as five simultaneous tows with closing nets and know the exact depth of each catch. In this method the wire is so heavily weighted that it remains practically vertical during the tow and the nets are fastened to it one below the other at known intervals. A system of messengers sent down the wire operate the opening and closing devices of the nets. Not only are the opening and closing devices extremely satisfactory, but also a further refinement has resulted.

A New Method of Sounding.

The study of samples taken from the bed of the ocean has always been productive and has aroused considerable interest among geologists as well as oceanographers. The recent developments in this field have also much improved the accuracy and use of the observations. The old-fashioned piano-wire sounding machine can now be replaced by the accurate and almost automatic sonic method, so that the exact depth of the water can be found at all times. Formerly it took several hours to make each sounding and by the time the wire was hauled back aboard, the vessel could have drifted into water having a different depth. For all bottom sample work, the operation is made much easier by knowing the depth in advance. Otherwise several hundred fathoms extra wire may be run out before the observer is sure his sampling device has reached bottom. With any sampler more complicated than the ordinary sounding tube this may be a great disadvantage. The extra cable coiled on the bottom may kink and the instrument will probably be lost when strain is again put on the wire.

Samples from the Ocean Bed.

It is a great advantage to investigators if the bottom sample is brought up in a water-tight condition so that none of the fine washings are lost on the long haul to the surface. To meet these requirements much attention has been devoted of late to devising improvements on the simple " snapper " and other devices which have long been used. For example, various types of valves have been tried that will prevent the mud from washing out of the sounding tube. Other more modern samplers are designed to secure long cores of the bottom material. With the present equipment, samples up to three or four feet in length have been brought up, and these have shown that the deposits on the ocean floor are often stratified. It is through the study of such material that eventually the problem of whether or not the bottom of the present deep ocean has ever been above sea-level will probably be settled. Still another type of sampler has been gradually evolved that will take either sand or mud from the region over the continental shelf. Another type, mainly used in shallow water, brings up a given area of the bottom which can then be studied for the plant and animal life and their relations as a feeding ground of commercial fish.

There is reason to expect that in regions where the surface waters are not too warm, deep-sea animals can be brought to the surface alive, if proper precautions are taken. The cod end of the nets must be lined with some soft material so that the fish will not have their skin chafed off by the rush of water through coarse netting, and the hauling speeds must be so regulated that the animals have time to " decompress " on the way to the surface. The difficulty is that fish living normally in waters having a temperature of 4° C. will be killed by being brought through the surface layers which are usually very much warmer. It would seem that in winter, if tows were made in the northern seas, this difficulty might be eliminated and the fish brought back alive.

Ethnology and the Census of India.

By E. N. Fallaize.

The recently published Census of India is of special interest for the new light which it throws on racial problems in relation to current history. The new views expressed by the Census Commissioner on the development of the early civilizations forms a contribution of the first importance to the scientific study of Indian life and culture.

LIKE many other valuable official documents, the Reports of the Census of India circulate only among a limited public. Beyond a brief summary of the principal groups of figures, little of the vast store of information gleaned in this decennial survey of the population appears in the British Press. This is unfortunate, as it has been customary for the Census Commissioner in making his report to take a broad view of his functions, and to review the bearing of the data gained from the Census upon the current scientific and social problems to which conditions in India give rise. It is not too much to say that, had relevant extracts from the reports of the Census Commissioner of 1931 and some of his predecessors been made available to the public in readily accessible form, recent political discussion upon the problem of India would have been better informed.

A Monumental Task.

The Census of 1931 was the sixth of the enumerations of the people under British administration since the Census was inaugurated in 1881. It is difficult to realize fully the magnitude of the undertaking; but it has to be remembered that the area covered (which now includes Burma but excludes Ceylon) comprises no less than 1,808,679 square miles and the population enumerated includes 353 millions. This India transcends the bounds of what we, with our narrower horizons are accustomed to regard as a single country, and must be looked upon as a sub-continent. Its climates range from tropical to temperate, and within its boundaries it includes arid desert with an annual rainfall of five inches, and tracts in which there are five hundred inches of rain in the year. Its social and racial divisions and their cultures are no less varied than their geographical conditions. Every phase of culture from that of western civilization to that of the hunter and food-gatherer of the jungle is represented.

The fundamental problem in discussing the political future of India has been to adjudicate on the balance between the forces which make for unity and those which tend to disintegration. In other words, the question which confronts those who seek to avert the deadlock of conflicting forces, which in India continuously threatens to render discussion sterile and bar all action, is whether the disruptive elements which have been held in check more or less successfully until recently under British rule will outweigh under a system of self-government the forces which tend to promote and consolidate political unity.

Numerous are the currents and cross-currents which trouble Indian life to-day. The peoples are passing through a period of economic stress, exceptional even in that country where so many live habitually on the margin of subsistence. It is therefore difficult to isolate the forces which are at work in promoting unity or in accentuating division among the various races and groups which make up the population. Difference of race which at one time played a considerable part in political agitation, is still by no means negligible; but it now acts indirectly in various ways, rather than directly, in affecting political movement. The barriers between the different divisions of the people have proved to be rather those of language. Religion, on the other hand—and with it must be classed the socio-religious factor of caste—although a serious obstacle to settling the machinery of political organization, has made for unity on the whole, notwithstanding sectarian differences and the problem of the depressed classes and outcastes. In combination with the realization of a certain cultural homogeneity of India as a whole and a common history in the development of her civilization, it has fostered the growth of a national self-consciousness in the various sections and groupings of Indian society as against the outside world, even though internally they may be set one against another, as Moslem and Hindu.

Many Languages.

At the risk of inflicting tedium upon the reader, these statements may be illustrated by the following figures taken from the Census Report of 1931. The total number of languages shown in the present census returned is 225. Of these, 27 are Indo-European, or Aryan, spoken by 257 million people; 14 Dravidian, spoken by 72 millions; 156 Tibeto-Chinese, spoken by 15 millions; and 10 Austro-Asiatic, spoken by 5 millions; the total being made up by a number of languages unclassified.

These figures call for little comment. It will be noted that the Indo-Germanic, or Aryan, languages are spoken by nearly three-fourths of the population

of India. The large number of Tibeto-Chinese languages is to be accounted for by the fact that they are the languages for the most part of isolated hill communities, in which the original linguistic stock, owing to the lack of inter-communication, has developed into a large number of different languages and dialects, each spoken by relatively small numbers. The important distinction is that between the Aryan and Dravidian languages, which broadly set off northern India against the south. The former were introduced by the Arya who invaded India in the second millennium B.C., conquering the Dravidian-speaking peoples, whose languages are perhaps best known in their modern form by Tamil and Telugu. The very real barriers set up by these differences of languages, which have militated strongly against anything in the nature of joint political action in the past, by the irony of circumstance have to a great extent been overcome, certainly among educated Indians, by the use of English, which has served as a *lingua franca*.

Religious Differences.

The importance of religious differences in Indian affairs gives the returns under this head a significance which needs little additional emphasis. The principal groups are Hindus (239,195,000), Jain (1,252,000), Buddhists, mostly in Burma (12,787,000), Sikh (4,336,000), Muslim (77,678,000), Zoroastrian or Parsi (110,000), Tribal (8,280,000). The figures for the Hindus represent an increase of ten per cent. in the last decade. This is not entirely a result of normal increase in the population, but in considerable part arises from the assimilation by Hinduism of the "wild" hill and jungle tribes, a process which has been going on from time immemorial.

The Census Commissioner of 1931 was Dr. J. H. Hutton, already well-known for his work in connexion with the ethnographical record of the hill tribes of Assam which is being conducted under the Assam Government. As an anthropologist Dr. Hutton has grasped the fundamental character of the ethnological problem of India in its relation to current history. This constitutes his most original—and it must be admitted his most controversial—contribution to the study of the data of the Census. In order to indicate the bearing of Dr. Hutton's conclusions on current events, it is necessary to recapitulate briefly the generally accepted view of the ethnic relations of the peoples of India.

On broad lines the usual view of racial sequence in the occupation of India is that the earliest inhabitants were possibly a negroid pygmy race, of whom modern representatives survive in the Andamanese and the dwarf tribes living in the jungles of Malaya, Celebes and the mountains of New Guinea. Their existence in India is largely a matter of inference. This somewhat hypothetical pygmy people was succeeded by a race now represented by the jungle tribes of India and the Veddahs of Ceylon, known to anthropologists as the Pre-Dravidians, of whom the Australians are regarded as an extension. The Pre-Dravidians were followed by the peoples usually termed "Dravidians," although in its strict application this term refers only to language. In physical characters the modern so-called Dravidian, of whom the Tamil is a familiar type, is somewhat indeterminate, ranging from that of the very dark broad-nosed type, close to the jungle tribe, to something closely akin in appearance to the comparatively light-skinned narrow-nosed Aryan-speaking races of northern India. The Dravidians in turn were conquered by the immigrant Aryan-speaking invaders of the second millennium B.C., among whose descendants in northern India the Rajputs claim to be the purest in breed. Unquestionably, however, the modern races of northern India who claim purity of descent by this time have acquired a considerable admixture of the blood of the earlier peoples. In their wider ethnic relations the Aryan-speaking peoples link up with the Nordics, while the Dravidian-speaking people are regarded as a branch of a race of which the Mediterranean race of Western and Southern Europe is an offshoot.

A generation ago, in the Census Report of 1901, the late Sir Herbert Risley put forward certain views as to the racial affinities of the Indian peoples, which have served as the basis of later research in Indian ethnology. With the detail of these views we need not concern ourselves here. The main point of interest in his conclusions was that the Aryan invaders had imposed their culture on the Indian peoples whom they conquered, and were responsible for the development of the characteristic civilization of India, including caste, by means of which they aimed at preserving the racial purity of the ruling stock. This theory lent support to the political aspirations of the higher castes in their claims to racial superiority, agreeing as it did with the evidence to which they appealed in their sacred literature.

A Crucial Discovery.

Although Risley's theories as to the racial origins of India long held the field as the orthodox view, from time to time it has since been pointed out that the contribution of the Dravidian element to the culture of India was greater than had been thought.

The crucial event, however, in the study of the cultural history of India in this generation has been the discovery ten years ago of the prehistoric civilization of the Indus Valley at Mohenjo-daro and at Harappa, and of its affinities in Afghanistan. All show relation with Mesopotamia in the third millennium B.C., long before the earliest date attributed to the Aryan invasion of India. This discovery has demonstrated conclusively that the development of the early civilization of India had been more continuous than was thought and had not developed in isolation as Risley held; while the Aryans, as the Nordics elsewhere, are made to appear in their usual role as the destroyers, rather than the founders, of a civilization.

In view of these developments Dr. Hutton holds that the time has come for a fresh statement of the racial problem of India. In three chapters dealing respectively with the races, languages and religions of India, based in part on the data collected in connexion with the census, in part from his consideration of the evidence as a whole, he sets out certain hypotheses which must be regarded as the most important contribution of his Census to the scientific study of Indian life and culture.

In briefest outline, Dr. Hutton's view is that the dominant element in Indian origins is Mediterranean or Western Asiatic. He boldly accepts the Mesopotamian affinities of the Indus civilization as a whole, and postulates the essential unity of a prehistoric culture extending from Crete and the Mediterranean to India—a view towards which it may not be premature to say certain archaeologists are now tending. He is perhaps justified in affecting a greater certainty than the archaeological evidence warrants at present in view of his analysis of Indian culture. In one instance after another he assigns significant elements, characteristic of the Dravidian speaking people, to an origin in the Mediterranean or in Western Asia.

Bridging a Gap.

On the other hand Dr. Hutton argues that the traditional account of the Dravida goes to show that they were a city-dwelling people with a high standard of civilization, and that their culture agrees with that which has been disclosed by the excavations at Mohenjo-daro, thus bridging a gap which archaeologists find obscure.

How then does this affect the statement of the racial problem? Dr. Hutton, accepting the theory of a pygmy people followed by the Pre-Dravidians, now suggests that there were two waves of immigration of peoples of Mediterranean or Western derivatives of whom the later, a Dravidian-speaking race, possibly having an Armenoid (presumably Mesopotamian) admixture, were responsible for the culture of the Indus Valley. The racial analysis is carried further but need not be followed here. Enough has been said to indicate the trend of the argument by which the great development of prehistoric civilization in India has been attributed to the "Dravidian" element in the racial composition of the Indian peoples.

The Character of Hinduism.

It will be found that this view of the early history of the culture of India has profoundly affected Dr. Hutton's view of the character of Hinduism, which is by far the most important factor in the life of modern India. In dealing with the religions of India, Dr. Hutton examines the details of Indian religious belief closely. Analysing it into its component elements he arranges these elements in an ascending scale in which each is attributed to its racial origin. Here again he shows the importance of the part that has been played by the contribution from the west. Such features of Hinduism as, for example, the fertility cult of the mother-goddess which accounts for the importance of the female principle in the Hindu pantheon are shown to have been brought in by the "Mediterranean" people; while in the Hindu pantheon he sees the triumph of the gods of the conquered over those of the conquering Aryan.

It is worth while to note that Dr. Hutton's view of the building-up process of Hinduism accords well with the facility with which modern Hinduism has absorbed and continues to absorb the tribal deities of the wild tribes who from time to time are recorded officially as having embraced Hinduism. On the other hand he regards Hinduism as having grown up within the bounds of India and to that extent to be of indigenous origin. This, indeed, has been maintained by those Indian nationalists who press the claims of Hinduism as the representative and unifying element in Indian culture. It now has official support. Dr. Hutton's views are admittedly speculative and will be received as such by scientists, albeit with the respect due to the views of their author.

"PRACTICAL CHEMISTRY" is the title of an interesting booklet just published by Construments, Ltd., at 2*s*. The experiments described and illustrated may be carried out with the laboratory sets which are supplied for the home by this firm. Suggestions for original experiments are also given. A miniature chemical laboratory may now be purchased for a few shillings. The booklet is published from 18, Gray's Inn Road, London, W.C.1.

Sound Films in Education.

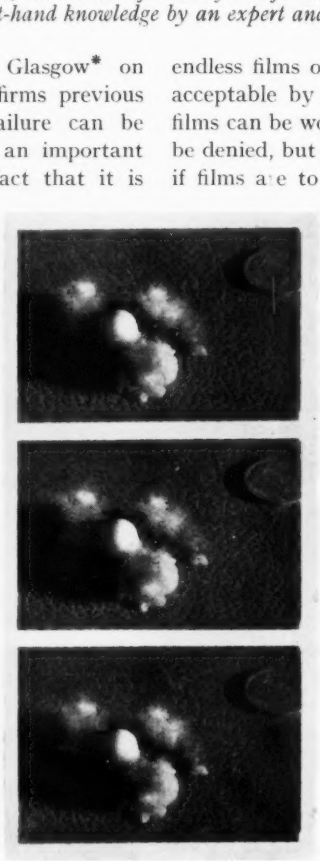
By L. E. C. Hughes, Ph.D.

The cinema is not a new factor in education, but the use of sound films for this purpose is a recent development. This important work is here discussed from first-hand knowledge by an expert and some of the latest equipment is described.

THE recent issue of a report from Glasgow* on experiments with class-room films reaffirms previous results and shows how success or failure can be measured, a vital point. The film is an important element in recreational life, and the fact that it is viewed with alarm by some social reformers testifies to its power, particularly on minds unformed. The impression which the best types of film can impose on those who are receptive is without parallel in any art-form, and the perennial questions again arise, can films be used to train the mind, are they being used, are they worth while?

Films are being increasingly used in all types of schools, colleges and educational institutions, either for vocational or cultural uses or merely for entertainment. That films bring fresh aspects of events and emotions into circumscribed lives cannot be denied, and the fact that commercial interests, in the form of the public cinema, do not entirely satisfy cultural demands is represented by the film society movement, culminating in the Film Institute as a guiding centre. The use of films for periodical entertainment in schools can in itself be of value beyond the moment, driving home subtle lessons of life or providing propaganda for artistic expression or amusement. The selector of the films presented is responsible for guiding and forming the taste of those who later must live as unfettered units and give a meaning to progress in our culture.

In many instances scientists have produced remarkable films as records of their work for the instruction of their students and for presentation to their fellow workers, many of such films finding their way into the more enlightened public cinemas. One recalls the Secrets of Nature series and biological work from Germany, among others. Public bodies, such as the late Empire Marketing Board Film Unit, have made endless films of propaganda value, some of which are acceptable by wider audiences. That some of these films can be worked into a scheme of education cannot be denied, but on a general basis of fitness for purpose, if films are to be employed as a standard article for school use as text-books or maps are, the films must be specially produced, with the proper motives behind them, to fit in with a recognized curriculum. The use of existing films may be a temporary expedient, but it would be taking the line of least resistance to modify curricula to suit some films which had been made with commercial or propagandist interest.



An enlarged strip from a film showing the hatching of a small egg. (Photo by J. D. Ridley.)

Such films are in constant exhibition at the Imperial Institute, while the Science Museum has inaugurated a bijou cinema, showing films made in the museum, to arouse interest in the exhibits and to appeal to the juvenile audience. The bar to special films is cost, not the want of knowing how to use them, for a new journal, *Sight and Sound*, is devoted to the subject and ample information is available, particularly from America,* where educational novelties find adequate financial support.

The cost arises mainly from the value of the idea to be achieved. We wish to hold the combined attention of eye and ear by images and related sound. In each element of the medium, proper filmic criteria must be applicable, the composition and clarity of the pictures must be right, the significance of the shots must be vital to the argument, the treatment must be consistent with no loose ends to raise side issues; in fact, if the film is to do effectively what other modes of expression cannot, the best theories of film editing must be at hand, together with able counterpoint between the scene and the accompanying subservient sound.

Such films require the taking of pictures, cutting them to the script, the addition of recorded sound,

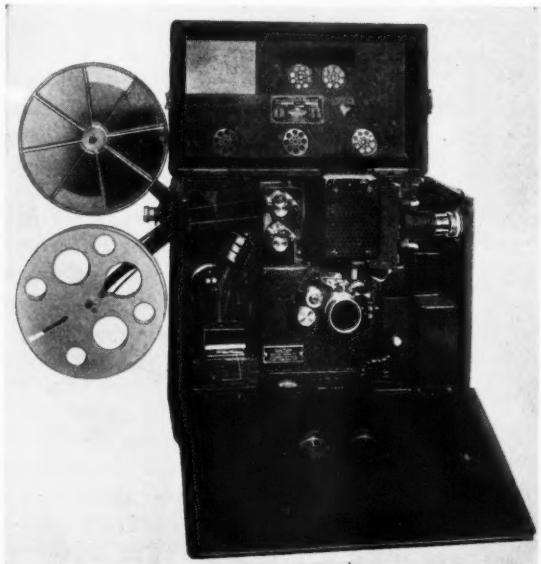
* *The Film in the Classroom.* (Glasgow Education Department. 6*d*.).

* *The Educational Talking Picture.* By F. L. DEVEREUX. (Cambridge University Press. 9*s*.).

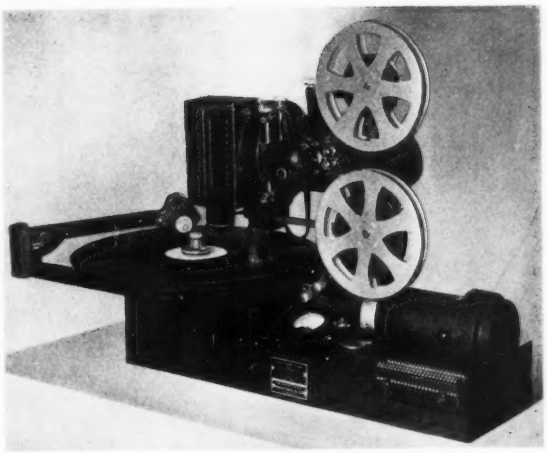
distributing copies on a sufficiently large scale to cover the cost, and projection. The very point which makes the film as a vital class-room adjunct is the immediate and restless way in which the immature mind can be carried from simple experiments which he can do with his fingers to the mighty activities which mankind bases on them. At a glance the reasons for burning hydrogen with oxygen, a small laboratory experiment, is related with cutting steel, an otherwise difficult task; the growing of seeds in pots is developed into providing the world with wheat; the slow growth of plants of germs, and the rapid flight of bullets or birds, is exhibited at a rate appropriate for explanation; complicated problems are analysed and synthesized with step-by-step diagrams interspersed with living views.

The use of films emphasizing the dignity of labour may bring back that sense of craftsmanship, always present in the highest quality machinery and even in the smallest mass-produced article, as has been shown repeatedly. The film, by providing a short cut between explicit theory and detailed practice, can be accurately adjusted to any degree of intelligence and offers a flexible tool of greater power than the static blackboard or lantern slide.

There are two ways of producing the required films, new examples of which have been recently experienced by the writer. The first was an amateur effort made by a schoolmaster on holiday as a geography lesson for his pupils. Entitled " The Outer Isles " it shows us the crofters of the Hebrides, their mode of work, their industries, their animals, crops and harvesting, with the fine characterization and consistent honesty we have learned to associate with the best documentary methods.



In this apparatus, manufactured by R. C. A. Photophone, the sound is recorded on the edge of the film.



In contrast to the apparatus below, the sound in the Western Electric equipment is recorded on discs.

As a contrast, and on a more ambitious scale, were a number of films made by Erpi for the University of Chicago. Here the film is an integral part of a " unit " of teaching, the aim being to view the film before and after a related discourse. One topic was the chemical phenomena of oxidation and reduction, relating laboratory experiments, some of them novel, with welding, combustion and the like. Another of the series dealt with electrostatics, from simple demonstrations to natural lightning discharges. In this type of film the utmost use of filmic devices are employed, with high-class animated diagrams, woven into a close argument by a crisp commentary.

As compared with the schoolmaster's effort, the American examples—more elaborately planned by expert conferences, provided with a sound-track, and shot on standard 35 mm. film-stock before being reduced to the sub-standard non-flam. 16 mm. normally required for class-room use—are expensive but they can be justified if they form a part of a scheme sufficiently broad to admit of adequate distribution. In other words, these are the type for use when the experimental period is passed.

As with broadcasting in schools, educational authorities must be reticent in spending public money on methods of teaching which appear to be expensive. The time seems to have arrived for a major trial in

(*Concluded on page* 50.)

New Birds from Africa—II.

By David A. Bannerman.

British Museum (Natural History).

There is a controversy among ornithologists as to whether the hordes of European birds which spend the winter in Africa follow definite routes or whether they migrate on a broad front ignoring landmarks. New light has been thrown on this important question by an expedition here described by Mr. Bannerman, the first part of whose article appeared last month.

THE territory in Africa through which Mr. George L. Bates travelled on his expedition along the borders of the Sahara desert (described last month) is so little known to Englishmen, and the information with which he has supplied me is of such general interest, that it must form the subject of a separate article in the future.

There is one aspect of Mr. Bates' investigations which I cannot omit to mention, however; I refer to his observations on bird migration. For it so happened that he arrived at Timbuktu in October, which is the month when the European migrants are just arriving at, or passing to, their winter quarters. Between October 14th and 28th the acacia bushes around Timbuktu were full of warblers, and as Bates observes, "many, if not most, of the birds around Timbuktu in October and November were migrants newly come from the north.

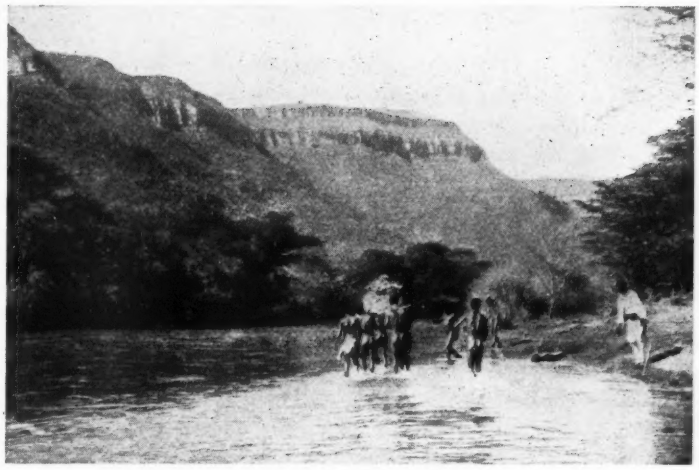
"For a part of these migrants Timbuktu is merely a halting-place on their way further south—being the port at which they land, as it were, after crossing the desert, as it used to be for trading caravans. But other migrants seemed to have found there the terminus of their journey and to be about to remain there all the winter." Many of these migrants—warblers, cuckoos, swallows, swifts, wheatears, whinchats, and many others, possibly from our own heaths and villages in England, make this prodigious journey annually, reaching at any rate the Savanna country of Nigeria, while others again cross the great forests of Cameroon, Gabon and the Belgian Congo to winter in Angola, Damaraland and even Cape Colony, but this again is a subject which can only be mentioned briefly here.

There is one aspect of migration which may happily be touched upon, and that is the controversy now going on in ornithological circles as to whether these hordes of migrants, which every year visit Africa to spend the cold European months in the tropics, follow definite routes such as the Nile Valley, and the coast-lines, or whether they migrate on a broad front, absolutely ignoring landmarks. In this connexion some very interesting facts have emerged from the journey undertaken by Major R. A. Bagnold, Royal Signals, and Major J. E. H. Boustead, across the Libyan Desert.

Migratory birds were observed and collected by Major Boustead throughout the journey across this desolate waste, which tends to prove that birds are passing south in autumn across the whole immense area; Mr. R. E. Moreau, who is analysing the results, informs me that the volume of migration is almost as marked between longitude 21° and 30° as it is down the valley of the Nile. When we realize that for hundreds of miles there is not even a well, and even where wells occur

A view of Timbuktu, visited by Mr. Bates on his recent expedition. (Copyright photograph by Capt. H. C. Brocklehurst.)

the water is often quite inaccessible, it seems obvious that these migratory birds can exist for long periods without water, and even without insect food, which in places like the Libyan desert must be almost non-existent.



A stream in the Arusi country, Abyssinia. An expedition to this country is described below. (*E.N.A. photograph.*)

The old idea that the shore-lines are used as landmarks, by which migrating birds "find their way," is no longer credible save for those birds which habitually live on our coasts, as, for instance, the Sandwich terns which are known to travel thousands of miles from the Netherlands, Denmark and Great Britain to the coast of Guinea and Angola. Distances of 3,700 miles "as the crow flies," the journey being undertaken between the end of June when breeding is finished, and the autumn of the same year, are now proven facts, thanks to the system of "ringing" which is now carried out systematically by ornithologists of many nations in whose territory the birds actually breed.

To pass to expeditions now in the field mention must be made of two which are likely to have striking results—the most important is that to the Belgian Congo by Admiral Lynes, who has recently been joined by Mr. Jack Vincent. The Belgian Congo, owing to the extent of dense equatorial forest which stretches from east to west of the territory, and to the presence of the great river which dissects it, is of paramount importance to the student of bird distribution in Africa. This vast forest acts as a barrier to a great many species of birds which range south as far as the Ubangi, Shari and Uele rivers, but which do not attempt to penetrate the forest wall; the point where the savannas begin to interrupt the forest is the inner limit of numbers of savanna farms, even though a few (as Dr. Chapin of the American Museum of Natural History—our greatest authority on the Congo area—asserts) may penetrate to artificial clearings within the forest itself.

It is too early yet to write of the discoveries in this region which Admiral Lynes and his companion will undoubtedly make in the nine months spent in the field. Their programme holds many possibilities, and we may hope for some evidence in proof of the racial difference shown in the birds which inhabit the Cameroons and the Upper Congo—a fact which Chapin suggests may be accounted for by the presence of the Great Lake believed to have been formed in the Pleistocene epoch, thus forming a partial barrier between the eastern and western sections of the Lower Guinea forest. This expedition, of which mention is here made, is primarily ornithological; both members are well known "bird men" and the ground has been well prepared in advance, so that no time will be wasted.

The other expedition, to which I have referred, is more geographical than ornithological in its objects. This has been undertaken by Messrs. Wilfred Thesiger and David Haig-Thomas with the object of surveying the course of the Hawash river in Abyssinia and as much of the surrounding country as possible, then to attempt to cross the intervening desert to Eritrea. At the same time attention will be paid to the bird life, and an auspicious start in this direction has been made, for Mr. Haig-Thomas has already shot and skinned several specimens of that remarkable species, the blue-winged goose (*Cyanochen cyanopterus*), concerning which very little is known, and of which the British Museum formerly possessed but two ancient examples. The geese were shot at the end of a long march and "skinned with a penknife by the light of a candle," but notwithstanding they have arrived in good condition at the Natural History Museum and form a most welcome addition to the National collection.

This article deals primarily with work already accomplished, but before this is in the Press another British Museum collector will be in the field. It has long been the desire of the writer to find someone who would undertake the investigation of the bird life in the forests of Ashanti, for not since the days (1867-1872) when Governor Ussher administered the

Gold Coast Colony has any serious collecting been done. It has now been arranged with the authorities of the British Museum (Natural History) that Mr. Willoughby P. Lowe should proceed immediately to Kumasi on behalf of that institution, and although Mr. Lowe will have many irons in the fire (small mammals will be one of his chief objects), birds will form a prominent part of his programme. He hopes to rediscover some remarkable species of which the Museum possess but single specimens, or perhaps two or three ancient native-made skins without exact data, sent to Governor Ussher "from the interior," and presented by him to the Museum many years ago.

For instance, there is known to live in these forests a spotted-breasted ibis, with long bill like a curlew and the forepart of the face bare of feathers, a long glossy dark green crest overhangs the crown and the breast of cinnamon-colour has each feather bordered with dark greenish-brown. Then there is the long-tailed hawk, a bird about the size of a buzzard, slate-grey above, chestnut below, with a black tail thirteen inches in length ornamented with white spots. Nothing is known of the habits of this hawk, which has never been seen or obtained since 1870. Of smaller birds there are several which have remained "unique" since the day of their original discovery, and who knows what new birds the forests of the Gold Coast may hide.

I can think of no part of Africa from which we may expect greater things. Mr. Lowe (whose book *The Trail that is Always New*, the narrative of previous expeditions, was reviewed in *Discovery* at the time), has been instrumental in obtaining over ten thousand specimens of birds for the Natural History Museum in the course of his life from many parts of the world, and no one is more capable than he of wresting the ornithological treasures from the hidden depths of these Gold Coast forests.

Secrets of Arabia.

In this article I have dealt only with recent expeditions made in Africa. Others equally important have been taking place in Europe, Asia and the Pacific islands. Of these there is no space to write. Even Arabia is at last giving up her secrets which for generations have been wrapt in mystery. Twice within a short space of time the Rub Al Khali has been crossed by two intrepid explorers, Bertram Thomas and H. St. John Philby, and both have added materially to our knowledge of the natural history of "The Empty Quarter."

In Africa, which has probably received more than its share of attention from British ornithologists within the last few years, the gaps are fast being filled. Soon there will be standard works dealing with the birds of every British Colony, and thanks to the collectors and trained observers in the field we can now write with as much authority of the birds of Nigeria, Somaliland, Kenya or the Belgian Congo as we can of almost any European country. Biological problems are being tackled, laws for the preservation of the birds and mammals are being introduced, and International Agreements arrived at with the object of preserving those species which for one reason or another merit special protection.

In other words, ornithology in Africa is making enormous progress, and if our knowledge of the birds of that Continent increases as rapidly in the next few years as it has in the period under review, the few remaining blanks on the map of knowledge will very soon be filled.

Sound Films in Education.

(*Concluded from page* 47.)

the fields in which the film is of most use, that is, in science and geography. The purchase of projection apparatus can be evaded for a while by using the comprehensive hiring system now available. For teaching aspiring engineers, the use of films in exhibiting the operation of large-scale plant is indispensable, short of an actual visit. The Post Office makes extensive use of films in training their installation and maintenance staff.

A novelty in class-room teaching of science and technology is the "cycle film," a print a few feet long, jointed end to end and continuously projected. The animated picture is that of a continuously repeated cycle of effects, of which there are untold numbers in physics and engineering, such as mechanical vibrations, acoustics and electrical alternating currents.

The use of synchronized sound reproduction with class-room films is a vexed question at the moment, but not in the writer's mind. The recent experience of documentary films in which speech is deliberately rejected in favour of time-wasting titles, with the accompaniment of elaborately scored music, indicates to the writer that if sound can be available, the spoken word, reasonably handled, can help both film and pupil.

The combination of the two channels of reproduction, pictorial and aural, was invented barely eight years ago. It has proved a medium of penetrating expression in many ways, but in using this latest child of science we must proceed slowly, for in the matter under discussion mistakes cannot be afforded.

Breeding Dogs for Intelligence.

A Discussion by Zoologists.

The suggestion that an experiment might well be made in breeding dogs for intelligence, in contrast to the practice of breeding purely for show points, is discussed in an interesting series of articles appearing in "The Countryman."

In their book, "The Science of Life," Mr. Wells and Professor Huxley suggested that it would be worth while to breed fifty generations of monkeys for intelligence and "to see what happened." *The Countryman* proposes that the experiment might better be attempted with domestic animals with which we are on more familiar terms.

Dr. F. Fraser Darling, of Edinburgh, who opens the discussion, has already made a close study of the subject. His first question, almost inevitably, is What constitutes intelligence? And how can it be measured in any experiment designed to breed for that quality? In attempting to interpret any incident in animal behaviour, he writes, we must fit that incident into the pattern of the animal's environment, orientate it, as it were; then we must analyse it. We may find that the incident, superficially a single one, consists of several discrete items of mental and physical action, and it becomes possible for us to assess, in some measure, whether it is intelligent or not.

Dr. Darling takes an example from bird life, where instinctive action plays an enormous part in behaviour. An eagle has been seen to fly at a hind, which was in a disadvantageous position when climbing a steep place on a Highland hill, and beat the hind over the cliff edge so that it was killed on the boulders below. Eagles do not ordinarily attack grown deer. In this instance the eagle had to know several things at once—that death or injury of the deer would follow a fall from the cliff, that the deer was in a position where it could not run away or retaliate and that its own talons and beak were not the direct weapons of death or of acquisition. The co-ordination of these separate items leading to a successful issue (for the eagle), writes Dr. Darling, constitutes an act of intelligence. Further, the eagle departed from habit.

Experiments with Collies.

This writer points out that the experiment of breeding dogs for intelligence has already been carried out with success in the case of working hill collies, which have been bred for hundreds of generations. The result is that their general behaviour has become far more what we might consider intelligent than that of most other dogs. "In the hill collie, there is the instinctive urge to herd, as there is in wild dogs, and if we were to base our opinions on trial behaviour we might not say that the dogs were intelligent, because they act on well-defined cues given visually or aurally by the shepherd—conditioned reflexes. But on the home hill, the collie has frequently to think for himself, because he may be round the shoulder of a hill from the shepherd or there may be a mist which completely shuts him off, yet he does his work, coping with the particular difficulties of each individual incident. There is cognation. These dogs, clever in the one way, have usually the potentially unfortunate capacity to be clever in others. They become excellent ratters and coursers unless checked, and the German shepherd dog (Alsatian) has produced the foremost police dogs. The untrained Alsatian is considered dangerous; so would be an untrained hill collie. So it may be concluded that when there is definite intelligent behaviour to be bred for, constantly being tested, positive results may be expected."

What is "Dog Intelligence"?

The discussion is continued by an American zoologist. Professor L. C. Dunn of Columbia University, who explains that, although he has owned dogs and bred a few, he is more accustomed to the study of heredity in mice, rabbits and fleas. He asks "What exactly is it what we want to know about dog intelligence? We think of a man as intelligent when he is able to react successfully to a new situation containing not quite the same elements as those encountered in his previous experience, and generally we expect him to have in addition to this reaction a good deal of knowledge, accumulated by a process of sifting the many items of his experience and retaining those of general significance for his life. Thus, to the ability to learn, he adds a certain originality and critical judgment. Of these qualities we expect chiefly the first from the intelligent dog—that is, learning ability, and I suspect that what we call intelligence in dogs consists largely of 'educability.'"

This, Professor Dunn suggests, is near enough to the truth to serve as the first or preliminary basis of a plan for breeding dogs for intelligence. A prime requirement of any experiment of this sort is that the quality to be dealt with shall be measurable in objective and fairly simple terms. Thanks to the animal psychologists and animal trainers, a number of methods

for measuring learning ability are now available. The psychologists are not at all certain how far these methods measure intelligence; but if we choose the more modest goal of increasing learning ability, this uncertainty need not bother us at present. These methods involve generally some variant of a scheme for measuring the speed and accuracy with which an animal learns.

The First Step.

Professor Dunn mentions the familiar example of the conditioned reflex provided by Pavlov's experiments with dogs. (When a dog smells meat his mouth waters. If, whenever meat is offered a bell is rung, after a time the dog's mouth will water when he hears the bell, a sound having been substituted for a smell.) "Conditioning" of this kind, with variations, has, of course, been the basis of thousands of intelligence tests for many animals, notably rats. Professor Dunn points out that tests applied to dogs must be adapted to the native peculiarities and capabilities of each distinct breed. Some breeds, for instance, are air-smellers, others keep their noses to the ground; there are runners and jumpers, barkers and silent dogs, swimmers and land dogs; and in each, a set of other reflexes are associated with some major peculiarities of sense perception. The behaviour of each breed has thus a certain unity, a frame within which the dog is most at home. The definition of this frame, that is the description of the dog's normal behaviour and capacities both in sense perception and actions, is thus the first step in any programme.

With this recognition of the importance of natural differences (many of which are certainly inherited) arises a serious question: Shall we attempt to make our ideal dog a mosaic of the several abilities now scattered in the various breeds, or shall we stand on the shoulders of the breeders of the past who by selection and inbreeding separated these breed peculiarities from the complex of what was once "just dog"? A great deal depends on the time at our disposal, since the first method with its larger goal is incomparably longer than the second and more modest one. As a student of heredity and "one who likes the pleasure of seeing a few results in his own lifetime," Professor Dunn would choose the latter. "In any case, the study of the learning capacity of the purer breeds would have to be made for it is stupid not to know that we are combining.

"I would not pose as an opponent of crossing in general. Cross-breeding is very useful in its place and is the basis of one of the most profitable methods introduced by modern genetics into agriculture—i.e., the so-called double-cross technique so largely used in breeding maize in America and used to a lesser extent with swine and poultry in several countries. But the advantages of this method arise from the use of stocks first purified in inbreeding and of known performance and peculiarities, and such stocks must be maintained continuously as parents of hybrid progeny. In dogs the situation is different. There are few strains which have been purified by inbreeding, and we know too little of the potentialities of the breeds, and this defect should first be made good. Beyond this, dogs are among the most variable of animals, with a long history of domestication and of selection in divers directions, which has preserved and multiplied the natural variations in a species which was probably not pure in the first place.

"Finally, we deal here with characteristics which are much more complex than any hitherto dealt with by scientific breeders, depending as they do on structural, nervous, glandular, and other physiological conditions which must be adjusted one to the other to produce any mental or behaviour trait. It is easy to take the colour from one breed and put into another; it is absurd to think we can so simply lift out a peculiar sensory capacity and insert it in a foreign environment. I do not deny it can be done, but in our present state of knowledge it is difficult and costly—and tedious." Professor Dunn stresses the importance of raising the standard of tests as breeding experiments progress. Breeders should study the method of inheritance of any trait which proves amenable to analysis.

Comparing Cats and Dogs.

Another contributor to the series is Professor John Tait, of McGill University, in whose laboratory conditioning work is carried on largely on dogs. He points out that dogs are more subject to external inhibition than cats. A conditioned cat, for example, will perform before an audience, when a dog in similar circumstances is put out of action. The cat is far less disturbed by extraneous or accidental noises than is the dog. The cat's discrimination of different intensities and different pitches of sound is not nearly so sharp nor so long and persistently retained as is that of a dog. Because of these discovered differences Professor Tait has planned to compare wolves, foxes and larger "cats" with a view to eliciting, if possible, (1) the reason why primitive man found the dog so suitable for domestication, and (2) whether the domesticated dog has, because of its domestication history, undergone cerebral change. (This matter is complicated because the common seal, *Phoca vitulina*, accommodates itself forthwith to the society of man.)

Correspondence.

THE SINAI CODEX OF THE BIBLE.

To the Editor of DISCOVERY.

SIR,—The support of all those who are interested in the establishment of the correct text of the Bible is invoked by the Trustees of the British Museum who, as is now well known, have the opportunity of purchasing the Codex Sinaiticus for the National Collections.

The earliest evidence for the Greek text of the Bible is found in papyrus manuscripts, some of which date as early as the second century after Christ; but these represent only fragments of some of the books. The earliest substantial texts are vellum manuscripts of the fourth century, and of these there are only two, the Vatican manuscript, nearly complete, and the manuscript which it is now possible for this nation to acquire from the Soviet Government. It may be mentioned in passing that these are some five centuries earlier than any of the manuscripts of the Hebrew text of the Bible. The Sinaiticus is now offered for the sum of £100,000. In making a statement to this effect in the House of Commons on December 20th last, the Prime Minister said that the Government would make a special contribution towards the purchase price of one pound for every pound collected from other sources. It is therefore necessary to raise at least the sum of £50,000. It would be excellent if the whole £100,000 could be raised by voluntary contributions.

The King has made a personal donation of £100, and The Queen one of £25, these gifts being accompanied by an expression of Their Majesties' keen interest in the steps which the Trustees are taking in the matter. At the moment of making this appeal, a sum of approximately £7,000 has been received from all sources, for the most part in quite small amounts. But special mention must be made of Lord Wakefield's contribution of £1,000, and of the efforts of the "Friends of the National Libraries" which have so far brought in £1,400. Much can be done by helpers who are willing to organize collections of small sums from those who are unable to give largely, and to forward them in bulk. The Vendors have given an undertaking that the money paid will be spent in this country. In other words the £100,000 will be a credit to be used in Great Britain.

It is unnecessary to dwell at length on the desirability of the acquisition. But it may be observed that it is not merely for sentimental reasons that it is necessary that the original of so precious a document should be in a place of security, and accessible to students. Scrutiny of the manuscript has already confirmed the opinion that no facsimile, however photographically accurate, can take the place of an original when it comes to deciding finally the exact significance of a correction of the text; and this manuscript contains many corrections by students of the time immediately following the date of its production, students who had earlier authorities at their disposal. Nor is it necessary to point out that the price, high as it may seem, is not exorbitant. It is less than half the sum which was asked for the manuscript but recently. It is less than has been paid by the nation for a single Renaissance picture.

The Trustees appeal with complete confidence to the generosity of the public, and will welcome and duly acknowledge any contribution, however small. Such contributions should be sent as soon as possible to The Director, British Museum, London, W.C.1., or to the Westminster Bank, Ltd., Bloomsbury Branch, 214, High Holborn, London, W.C.1, or may be paid into any bank in England, Scotland or Wales, for the credit of the Sinai Bible Manuscript Account at Westminster Bank, Ltd., Bloomsbury Branch, London, W.C.1.

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SCIENCE AND RELIGION.

To the Editor of DISCOVERY.

SIR,—The Bishop of Durham says with perfect truth that "science divorced from ethics carries a potency of measureless calamity for mankind." We have only to remember that while science has increased the expectation of life of the average person, the lunacy figures for some years have shown a steady upward trend. Surely science has some responsibility for these conditions?

But, then, what of the scientific obligations of the moralists, if I may so express a thought, which I can best illustrate by an experience I had some years ago, when on one of my visits to Western Canada. Here I was overtaken by an urgent message from one of the public authorities on the Clydeside: "Could the Salvation Army Migration and Settlement Department undertake to transplant some twenty ship-builders, who had become public charges?" Enquiry showed that these workers had become unemployed as a direct result of the Washington Naval Treaty of 1922. Moralists, doubtless, were highly satisfied with that treaty, but why did they not see to it that the inevitable reaction of displacement of labour was squarely faced and provided for? I suppose such a problem, like so many others, is at one and the same time a moral and scientific one, but surely not beyond our wits to devise a solution?

DAVID C. LAMB,
Commissioner.

The Salvation Army International Headquarters,
London, E.C.4.

SIR,—Mr. Belloc's article, "What is the Issue?" is really an exposition of Mr. Belloc himself! Science does not rely on dogmas, but on investigation, free and open-minded, ever changing its old ideas for truer ones. Science refuses the hasty and false generalizations of religion, comforting though they are.

Manchester. GILBERT T. SADLER.

SIR,—I was glad to read in *Discovery* Mr. Hilaire Belloc's understanding analysis of the "conflict" between science and religion. I am surprised that no one has put the case to the public in this way before. During the past twelve months I have read two articles by eminent scientists in which the authors stress the fact that we are becoming carried away on the tide of scientific progress, until the destiny of civilization itself is beyond our control.

London, S.W. W. H. SHEPHERD.

A HISTORY OF THE WHITE STAR LINE.

To the Editor of DISCOVERY.

SIR,—I am hoping to prepare a history of the White Star Line. May I ask all those who have memories, papers, letters, logs and photographs of the officers, crews, sailing-ships and steamers of this line, to be so kind as to write to me, and to let me know the nature of their material?

Pinbury Park, Cirencester. JOHN MASEFIELD.

Book Reviews.

Inland Waters of Africa. By S. and E. B. Worthington. (Macmillan. 15*s*.).

Dr. and Mrs. Worthington give us in this fascinating book a general descriptive account of the work done on two scientific expeditions to the great lakes of Africa. It is surprising to read how much of this part of Africa is so untouched that even crocodiles do not bother their heads about man. The authors describe Crocodile Island, hitherto unvisited even by natives, and give an account of Lake Rudolf which, they say, is no place for human beings. They tell us of the remarkable contrast between Lake George, a shallow swamp, and Lake Bunyoni, a drowned mountain valley with only a few introduced fish. They discuss the ecology of the lakes and establish the food-chains of which the natives make very practical use. We are given accounts of the various methods and apparatus for fishing employed by the different tribes on the different lakes. It is to be noted that they employ the universal sheet bend.

The evolution of native craft is described in an interesting chapter. It has proceeded along two lines, the raft, beginning with a bundle of reeds lashed together, and the dug-out. The lashing of a wash-strake along the gunwales is the first step towards the modern clinker-built boat. In Africa this evolution reaches its climax in the splendid war canoes of the Baganda, which so impressed early travellers, including Stanley; he saw them over seventy feet in length carrying a crew of sixty-four paddlers. Here the authors seem in favour of independent invention with local evolution, although they admit a restricted diffusion from tribe to tribe. The difficulties in the way of the theory of the diffusion of the bifid prow from the Nile southwards to Lake Victoria and northwards to Scandinavia, or of the theory of an Indonesian origin, make them difficult to accept. One is apt to forget how much primitive naval architecture is dependant upon the local flora.

The authors describe the remarkable success that has attended the introduction of trout into the hitherto fishless alpine streams of Kenya. There is no danger that they may threaten the local fish fauna, for although some individuals may become acclimatized, the ova remain true to their circumpolar origin in becoming addled at a temperature above 58° F., which prevents their multiplying below the 7,000 feet contour. Some of the lakes are almost fishless, as Naivasha in Kenya, where before 1925, there was only a useless minnow-like little thing, but in that year the Fish Warden, Mr. R. E. Dent, introduced the edible *Tilipia nigra* so successfully that within three years it was a recognized supply of food. As the lake is too warm for trout, he next introduced black bass to feed on the *Tilapia* and provide food and sport for anglers to whom the water was thrown open in four years. The practical result was that the value of land along the shores jumped from 10*s*. per acre to £10 and even £20 and local trade received a tremendous impetus. The authors are careful to bear in mind the danger of thoughtless introduction which is justifiable only under rigid scientific supervision, otherwise incalculable mischief may be done.

The numerous puzzles provided by nature in the lake region of Africa are well on the way to solution. It is only recently that *Tilapia esculenta* of Lake Victoria has been recognized by zoologists, yet for twenty-five years it has been a familiar dish on the dinner tables of Kenya and Uganda. In chapters XIV and XV the authors give a clear outline of the involved geological history of East Africa, which explains the numerous anomalies of the fauna of the lakes; why, for instance, there are no crocodiles now in Lake Edward where fossil remains show they were once common.

There is little to criticize in this excellent book. On p. 117 the authors state that the darter, *Anhinga rufa*, catches its fish only by transfixing them. A good many years ago there was a specimen in the Old Fish House at the Zoo, which was a show sight at feeding time, when it could be seen in its glass tank swallowing the small fish alive under water as fast as it caught them. The Nile perch is not the largest freshwater fish. It is beaten by the sheat fish, *Siluris glanis*, and many times over by the *Huso huso*, greatest of the sturgeons. Berg alludes to specimens weighing a ton and a half.

Witchcraft and Demonianism. By C. L'Estrange Ewen. (Heath Cranton. 25*s*.).

The God of the Witches. By Margaret A. Murray. (Sampson Low. 8*s*. 6*d*.).

Belief in witchcraft may be regarded as a vulgar superstition, and interest in the subject as morbid curiosity; yet the wave of witch persecution which swept Europe from the fifteenth to seventeenth centuries is one of the most interesting psychological phenomena in history and one of the most difficult for the modern mind to understand. The two books here reviewed represent opposite schools of thought in approach to this intriguing problem. Mr. Ewen is a realist. He regards the belief in witchcraft, in so far as it was based on "facts" recorded in evidence, as due to a misunderstanding of the real nature of the alleged facts. Dr. Murray on the other hand holds that witchcraft in medieval times was a surviving, but nevertheless living, cult inherited from our pagan ancestors, and that the reports of the witchcraft assemblies known as "sabbats" and the details of the cult observance as recorded by the writers on witchcraft or elicited in some of the trials were true and authentic accounts of what actually took place, accepting, however, a human impersonator for the devil, the nature or fertility deity, whom the devotees confessed they had worshipped in the witchcraft ceremonial.

In her latest book on the witch Dr. Murray again surveys the material from this point of view and traces the central figure, the devil, back through the horned deities of the Celtic world, Greece and ancient Egypt to the figure wearing an animal mask which is represented in the palaeolithic painting on the walls of the cavern of Les Trois Frères at Ariège in France. The connexion between witchcraft and a fertility cult is indubitable; but whether it was anything more than a survival in the superstition of the peasantry, and was practised as a living cult, is open to question. The evidence is suspect. The details follow those of the Christian ceremonial in their exact opposite, e.g., the black candles, the ceremonial kiss, etc., too closely to be beyond cavil. The whole thing is artificial.

In England the alleged cult, as it is supposed to have existed among the people and not as it was practised later among perverts, never attained the highly organized character that was attributed to it on the Continent. Even the existence of the witches' coven or ritual band of thirteen, is difficult to prove conclusively, though Dr. Murray makes a bold attempt. We do, however, hear constantly of the compact with the devil, perhaps because this came into the legal definition of the witch. Suggestion, no doubt, played its part. How far the English evidence carries may be gauged from Mr. Ewen's excellent digest of the evidence and the depositions in the period from 1510 to 1717. This covers practically the whole legal history of the superstition in this country. He has added much new material

as the result of a protracted research among legal records, and in a temperate and well balanced introduction he has surveyed the evidence thus collected from all sides in its bearing on the problem of the essential basis of the belief. This is a work of considerable value.

Religious and Cosmic Ideas of Central Polynesia. Two vols. By R. W. WILLIAMSON. (Cambridge University Press. 50*s*.).

In these two volumes the author, who died in 1931, has made a critical digest of the literature dealing with the mythology and religious beliefs in the islands of the Pacific which extend from Samoa to the Marquesas. It carries on the work of an earlier book published in 1924 in which the literature relating to the social organization of the same area was treated in a similar manner. Fortunately at the time of the author's death the present book was already in proof and in a sufficiently advanced state for it to be seen through the press by others.

The critical treatment of the vast literature dealing with Polynesia, to which Williamson devoted the later years of his life, was a task for which he was peculiarly well fitted by both temperament and training. At the same time he was no mere armchair theorist. He had had experience of field work in an expedition to the mountainous country of New Guinea and to Melanesia. This stood him in good stead as a preliminary to carrying out this great work of his planning. The two books taken together form one study of the Pacific which will be indispensable to scholars and a mine of thoroughly tested information for those in future who wish to study past conditions in the Pacific. These works are, however, far more than that. Williamson, following the lead of the late W. H. R. Rivers in his *History of Melanesian Society*, has analysed his material thoroughly and shows that the religious beliefs and their accompanying cults point to a stratification in Polynesian society. Certain of the beliefs, it is demonstrated, form a complex, which must be assigned to an "archaic" culture—a conclusion which, as Williamson points out, both supports and is supported by the conclusions at which Rivers arrived in his study of Melanesian society.

Romanian Furrows. By D. J. HALL. (Methuen. 10*s*. 6*d*.).

The author is not a man of science but a philosopher and an artist. In an earlier work, *Enchanted Sand*, he showed how necessary it is to dissociate oneself completely for a substantial period from the home environment if one would form a truer idea of relative values. In this equally delightful book he has two clear messages for us. The first is that the peasants of Romania have the laugh of us. They own their own farms, are self-supporting and happy in their independence. We receive the impression of a cheerful, simple but not foolish, contended population, strong in its direct contact with the soil.

The second lesson comes at the end, in two grim chapters describing the gloom along the narrow Dniestr that divides the now Romanian province of Bessarabia from Bolshevik Russia. This atmosphere is conveyed with a gifted pen, and from it certain facts stand out. The first is that, however much the Soviets try to entice the Romanians to follow their road to salvation, the flow is *from* and not *into* Russia. And at what a price! Not hundreds, but thousands of Russian peasants, to escape from the utter misery of their lives, are willing and anxious to abandon their country and, with no resources whatever, to flee to a strange land and, what is more, in doing so to risk the bullets of the frontier guards, not of the Romanian to keep them out, but of their own people to keep them in. All along that frontier, every three hundred yards, there are Red soldiers with rifle and machine-gun. They keep up a rattle of fire all night, *pour encourager les autres*. Many victims fall by the wayside but, year in and year out, many filter across to safety.

Mr. Hall does not tell us of that other Romania of which we hear more, the frivolous urban population which has given the country a reputation it does not deserve. But he shows that there is, not as with us a gradual passage from class to class, but the old primitive division into owners and owned, the latter now free, between whom there is a wide gulf fixed. In Romania this gulf is not only social but racial. Conditions in Romania before the war were not unlike those in Russia, a wealthy squirearchy, the evils of absenteeism and an ignorant peasantry with only perfunctory interest in its work. The awful example of Russia, so near at hand, was a terrible warning. The reform was inspired by panic and has been a phenomenal success. Let the trader and the official lament that the peasants are so lazy that they will not produce corn for export. Why should they? They produce enough for their own requirements. They are not lazy, but too wise to waste their energies upon a mere material reward.

On reading Mr. Hall's book, we are tempted to ask whether it is not painted too *couleur de rose*? Are they really so happy? Has he not over-idealized them? Is there so unspoilt a people left in Europe? Are they really so independant of the world-wide depression? If this is true, then indeed the lesson to us is a very clear one.

Pindorama. By DESMOND HOLDRIDGE. (Putnam. 15*s*.).

The author is an ethnologist of the Brooklyn Museum and clearly an enthusiastic one, for he went through immense discomfort and considerable danger when he undertook his one-man expeditions into Pindorama, which is the musical Tupi name for the valley of the Amazon, with little equipment except trade goods to barter for services and specimens. His best asset, as he himself admits, were his courage and his tact, the two indispensables in dealing with savages. He writes sanely of the relations between white and brown, of missionaries and the odd effects of their activity upon their victims, of the impact of race upon race and of the destiny of primitive man. He spent some time in the scarcely known region along the Venezuela-Brazil frontier, the divide between the Amazon and Orinoco, where their headwaters are only six hours ride apart. Here he discovered unmapped rivers and mountains.

We find interesting resemblances to African customs. Some tribes of the peaceful and artistic Aruaks file their teeth, as do the WaLuena and other Bantu tribes, but there is no suggestion of cannibalism; it seems to be for only an aesthetic motive. Like the African, they come to the white man to bandage their wounds, but quickly strip it off to use their own. Like the Africans, they have no conception of natural death, for any end that is not obviously violent must be due to witchcraft. They have considerable knowledge of drugs, for instance, of *uasi*, a vegetable poison which they place in the nostrils of sleeping persons who pine away and die, a method practised by the Sarts of Central Asia who use arsenic. They also use a form of tear gas to drive people out of their huts, and carry drugs under the thumbnail to poison the drink they are offering, another African custom. There is, of course, no suggestion of any connexion however remote, and the resemblance is due to like conditions

producing like results. Most of the strange beliefs and customs of primitive peoples have some logical basis. It is interesting, for instance, that some of these Amazon tribes practise the *couvade*, where the father retires to bed when a child is expected and the woman continues her work till the last moment. The object of this is to deceive the evil spirits who are hovering round to attack the child. It is remarkable that this custom is also practised by the Basques who, according to some, have other characteristics in common with the American Indians. Another tribe plasters itself with red paint for the same reason that white men in Africa wear red lining to their hats and clothing, for protection against the sun. Another curious observation is that in the case of the birth of twins, the father will accept the paternity of one only, taking the other as concrete evidence of his wife's infidelity. This explains why the women retire to produce their offspring, so that they can kill one if twins are born.

The author deals undecisively with the old tradition of female warriors which led the discoverer of the river, Francisco Orellana, three hundred years ago to give it its name, but records the remarkable fact that jade ornaments occur here and are highly prized. Unfortunately for those who seek here evidence of an ancient connexion with Asia, the jade is of a different character from the nephrite of the Kuen Lung, although its origin has not been traced. It can be only a coincidence that the word *shurimu*, translated as brother-in-law (p. 257), is almost identical with the Slavonic word for wife's brother.

There is plenty of adventure and a pleasing account of the big island of Marajó at the mouth of the Amazon, where the author made archaeological excavations and rode steers, living like a prince as guest of the wealthy owners of the ranches. He is of a cheerful disposition with the mental equipment of the real traveller.

The Lone Swallows and Other Essays. By HENRY WILLIAMSON. (Putnam. 5*s*.).

The greater part of this book consists of sketches written by Mr. Williamson between 1920 and 1933 (*The Lone Swallows* first appeared in 1922), but it also contains "A Boy's Nature Diary," written by him at the age of sixteen, in which we recognize the beginnings of that understanding observation which later made possible *Tarka the Otter*. He wrote, apparently in 1921, that ravens had come near to extermination. To-day they are well distributed in the Western Peninsula. He adjudges, and we must admit rightly, the little owl a bird-killer, but against this must be put the toll it takes of rats, mice and beetles. He has seen a cuckoo lay her egg in (not carry it to) a hedge-sparrow's nest. Young cuckoos, he tells us, are fed on their journey south not only by their parents, but by other pairs of birds with fledglings, who cannot resist its food call. It is well-known that young cuckoos are sometimes fed by birds not their foster parents. But whether manna is supplied to them in this way throughout their journey through the wilderness is a statement which needs much careful observation before it can be accepted as a fact.

In a chapter written in 1921 the author says that the nightingale does not come to the West Country. Even then this statement was not quite accurate, for a few pairs nested in Devon in that year. Since then they have bred there in increasing numbers. Sixty-one pairs were discovered in 1931, and a partial investigation recorded 45 in 1932, though probably the real total was as large as in 1931. Mr. Williamson makes his "Lone Swallows" fall victims to a peregrine falcon. This sketch must, we presume, be read as a story and not necessarily as a naturalist's record of observations; but it would be interesting to know if the author has actually seen a peregrine kill a swallow. This species is not mentioned in a long list of peregrine's victims in a well-known ornithological book of reference.

But too much carping criticism would be out of place in reviewing this book. Mr. Williamson is a nature lover akin to Richard Jefferies, to whom this book is dedicated. Whether he is describing the desolation caused by man when real country becomes suburbia, or those happier regions which are still lonely and unspoiled, he gets at the root of the matter. You see and feel what he has seen and felt. His sketches have the true smell of earth.

Myths and Legends of the Bantu. By ALICE WERNER. (Harrap. 15*s*.).

In this book "Bantu," strictly a purely linguistic term, is used for convenience to denote the peoples forming the bulk of the population of Central and South Africa, who, notwithstanding a considerable range of variation, show the negro as the predominant, but not the only, strain in their characteristic features. For English speaking peoples, the chief attraction in the stories which Dr. Werner has here brought together is the section consisting of animal stories, in which will be found the ancestral form of the famous Uncle Remus stories of Joel Chandler Harris. Here we find the prototypes of Bre'er Terrapin and Bre'er Rabbit comporting themselves with similar guile, if in different surroundings, to their American kin. Here, too, are stories of culture heroes. It will surprise those who are unacquainted with African idiosyncracies to find a version of Tom Thumb which has a strongly humorous flavour, and makes a distinct appeal to the European reader.

Dr. Werner's knowledge of African tales is unrivalled. She has supplied the stories with a running commentary and analysis and with frequent references to parallel versions. Her text provides an excellent introduction not merely to African folklore, but also to the whole system of Bantu religious belief, so far as this is embodied in myth as distinct from ritual.

Historical Geology. By RAYMOND C. MOORE. (McGraw-Hill. 24*s*.).

Dr. Moore, who is professor of geology in the University of Kansas, here describes selected observations in geology and interprets each in terms of history. The evolution of life on the earth is treated in chapters each dealing with entire areas or sub-areas. This is a wise arrangement, since the text is less disjointed than is generally the case when separate periods are dealt with. The inclusion of chapters describing briefly characters of the outcrop areas of the rocks of the various eras provides a valuable geographical setting for the more detailed considerations of the systems which follow. A wide range of geological data, brought together in a single region—the Grand Canyon—is provided in an important chapter on "The Historical Significance of Rock Characters." This study, based on a specific area, serves a more useful purpose than the mere elaboration of principles in the abstract. Many diagrams depict the successive stages in the development of the features of the earth, and the illustrations of various groups of fossils give a clear idea of the relative size of the types shown, by using the same scale for all figures of the assembled group.

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